TEK INSTRUCTION MANUAL

Part No. 070-2338-00
Product Group 20

1480-SERIES WAVEFORM MONITORS

(B060000 and above)

Tektronix
COMMITTED TO EXCELLENCE

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Please Check for CHANGE INFORMATION at the Rear of This Manual

First Printing MAY 1977
Revised MAY 1985

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SAFETY SUMMARY

The following are general safety precautions that must be observed during all phases of operation.

WARNING information in this manual is intended to protect personnel from hazardous primary voltages.

CAUTION information is intended to protect the instrument from damage.

WARNING

Electrical shock hazards are present inside this instrument. Only qualified service personnel should remove the instrument cover.

WARNING

To reduce the electrical shock hazard, the instrument chassis must be properly grounded. Refer to Section 1, Unpacking and Incoming Inspection.

WARNING

Do not service or make internal adjustments to this instrument unless another person, capable of giving first aid and resuscitation, is present.

Avoid live circuits. Electrical shock hazards are present in this instrument, especially in the power-supply primary circuits (fuse holder, power switch and transformer primary terminals), the high voltage for crt operation, and the +140 V supply to the Horizontal Output circuit board.

WARNING

The crt used in the 1480-Series Waveform Monitor is a high vacuum device and should be handled with care. Be sure to read the warnings and procedure for crt replacement in SECTION 7 before attempting to remove the crt.

WARNING

Avoid coming in contact with components that are operating at high temperatures, such as high-wattage resistors (spaced above the circuit boards), power transistors, some of the metal-can transistors, and some of the integrated circuits (IC).

WARNING

Handle silicon grease with care. Avoid getting it in eyes or mouth, wash hands after using silicon grease.

Power Transistors. The power transistors, that are heat sinked to metal parts of the 1480-Series Waveform Monitor, are mounted with silicon grease.

CAUTION

For continued fire hazard protection, replace mains fuse with the type and rating listed on the instrument rear panel and in the electrical parts list.

CAUTION

Read the soldering instructions in SECTION 7 before attempting to solder on the circuit boards contained in this instrument.

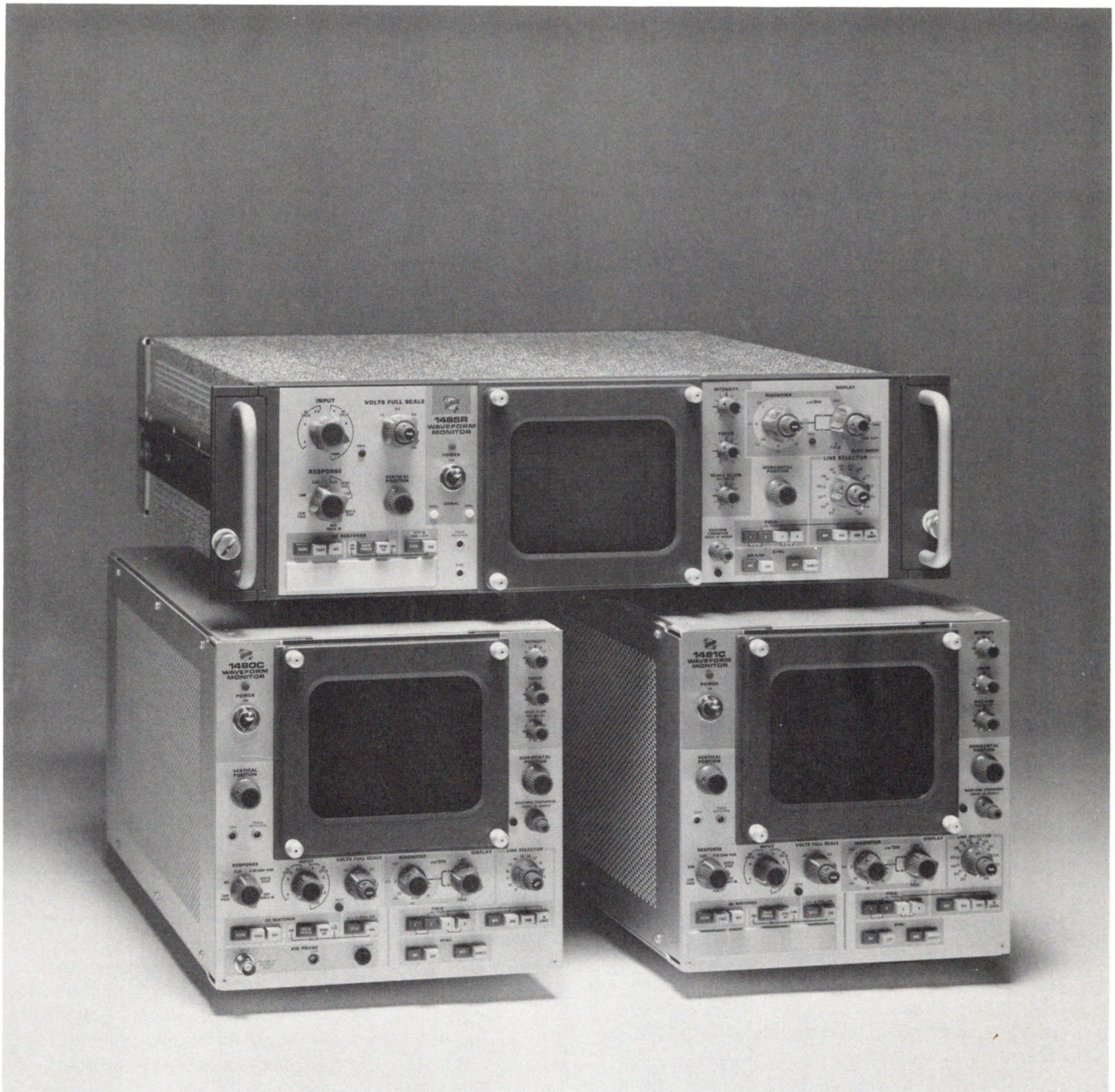

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Fig. 1-1. 1480-Series Waveform Monitors, showing both rackmount and cabinet models.

PART 1
OPERATING INFORMATION

INTRODUCTION

This manual is divided into two parts. The first part (OPERATING INFORMATION) is designed for use by anyone who needs to know how to operate a 1480-Series Waveform Monitor. Part two (SERVICE INFORMATION) contains the information necessary to maintain the accuracy of a 1480-Series Waveform Monitor. Part two should only be used by qualified service personnel; servicing exposes personnel to hazardous voltages.

UNPACKING AND INCOMING INSPECTION

The 1480-Series Waveform Monitor operates from a single-phase power source with one of the current-carrying conductors (neutral conductor) at ground (earth) potential. Operation from power sources where both current-carrying conductors are live with respect to ground (such as phase-to-phase on a 3-wire system) is not recommended, since only the line conductor has over-current (fuse) protection within the instrument.

The 1480-Series Waveform Monitor has a 3-wire cord with a 3-terminal polarized plug for connection to the power source and earth ground. The earth ground terminal of the plug is directly connected to the metal chassis of the instrument. For electric-shock protection, insert the power plug in a mating outlet with an earth-ground contact. Table 1-1 gives the conductor color codes of power cords used in Tektronix instruments.

TABLE 1-1

POWER CORD COLOR IDENTIFICATION

Conductor	Color	Alternate Color
Ungrounded (Line)	Brown	Black
Grounded (Neutral)	Blue	White
Grounding (Earth)	Green-Yellow	Green-Yellow

If a 3- to 2-wire adapter is used to connect the 1480-Series to a 2-wire ac power system, be sure to connect the ground lead of the adapter to a conductor that connects to earth ground. Failure to complete the grounding system may allow the metal parts of this instrument to be elevated above ground potential and create a shock hazard.

Damage Inspection

After carefully removing the 1480-Series Waveform Monitor from the shipping carton, inspect the instrument for possible damage incurred during shipment. Report any shortage or damage to the carrier.

Save the shipping carton and packing material in case you need it to repackage the instrument for shipment.

Included Accessories List

A complete listing of accessory items that are shipped with the various 1480-Series models can be found following the Replaceable Mechanical Parts list near the rear of this manual. The graticule (or scale) items that follow are part of the listing under Standard Accessories. They are also listed here as a convenience to the user.

The following crt scale is shipped with all 1480-Series Waveform Monitors:

Qty.	Description	Tektronix Part No.
1	Scale, crt: Blank	331-0393-00

The following graticules are supplied according to the 1480-Series configuration:

Qty.	Description	Tektronix Part No.
1	CCIR Composite (1481, 1482, 1485 Opt 3 & 1485C Opt 5)	331-0393-02
1	CCIR K-Factor, visual (1481 & 1485)	331-0393-05
1	CCIR K-Factor, photo (1481 & 1485 except Opt 3)	331-0393-07
1	NTSC Graticule A, visual (1485 & 1480 Opt 3)	331-0393-08
1	NTSC Graticule B, visual (1480 & 1485)	331-0393-09
1	NTSC Graticule A, photo (1485 except Opt 3)	331-0393-10
1	NTSC Graticule B, photo (1480 & 1485 except Opt 3)	331-0393-11

Optional Accessories

A variety of optional accessories, for use with 1480-Series Waveform Monitors, is available from Tektronix, Inc. The following, available through the nearest Tektronix Field Office or sales representative, are the most commonly used optional accessories:

Description	Tektronix Part No.
BNC Elbow, male to female	103-0031-00
BNC "T" Connector	103-0030-00
75 Ω 42-inch Cable, BNC Connectors	012-0074-00
75 Ω 300-inch (25 ft) Cable, BNC Connectors	012-0157-00
75 Ω End-Line Termination, BNC Connectors	011-0102-00
75 Ω Feed-Thru Termination, BNC Connectors	011-0103-02

Detailed descriptions and pictures of these and other optional accessories are in the Tektronix Television Products Catalog.

QUICK OPERATIONAL CHECK

It is possible to determine if the functions of the 1480-Series Waveform Monitor are operational without employing a full-fledged Performance Test. This check cannot take the place of the Performance Test that occurs later in this Instruction Manual.

An accurate video signal, with test signals in the vertical interval, is all that is required to determine if the basic display functions of the 1480-Series Waveform Monitor are operational. The source of this signal may be either a live video feed (with ITS or VITS) or a television signal generator, such as the 149A NTSC Test Signal Generator, 148 PAL or 148-M PAL-M Insertion Test Signal Generator.

The test methods outlined here are covered in detail in Television Products Application Notes 11, 12, and 20. Copies of these Application Notes are in Section 3 of this Instruction Manual.

Best results will be obtained when a composite test signal, either full field (if available) or vertical interval, is used. This procedure is not a complete performance test, but is a useful tool in determining if the waveform monitor is partially or totally operable.

Section 5 of this manual contains a thorough performance test, which should be used for incoming inspections or determining accuracy of calibration.

Hookup: Connect a video signal to the A VIDEO INPUT connector. Terminate (75 Ω) the other (loop-thru) connector.

1. Vertical Gain and Calibrator

Depress all dark gray pushbuttons. Set vertical INPUT to a A DC, VOLTS FULL SCALE to 1.0 and RESPONSE to FLAT. Adjust INTENSITY, FOCUS and SCALE ILLUM for a comfortable viewing level with the SCALE ILLUM knob pushed in.

While keeping the OPER pushbutton in, depress the CAL pushbutton. Check for the display in Fig. 1-2.

Leave both the OPER and CAL pushbuttons in and depress the SYNC TIP pushbutton. Check for the display in Fig. 1-3.

Push down the OPER pushbutton; this releases the CAL pushbutton. Adjust the front panel GAIN screwdriver adjustment, if necessary, for a 1 volt peak-to-peak or 140 IRE amplitude display.

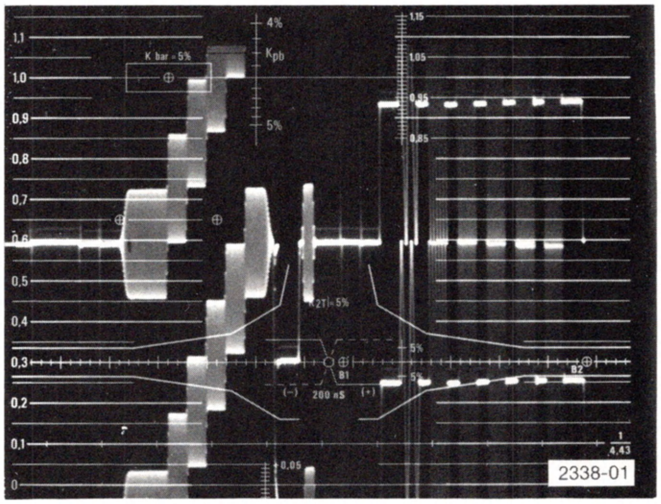


Fig. 1-2. Overlayed levels at backporch.

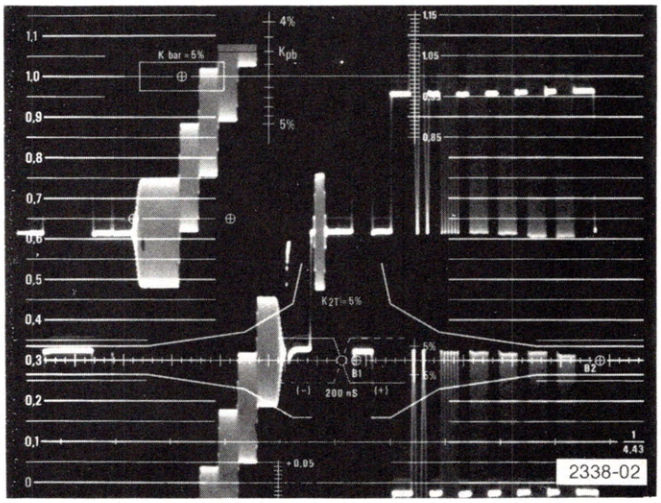


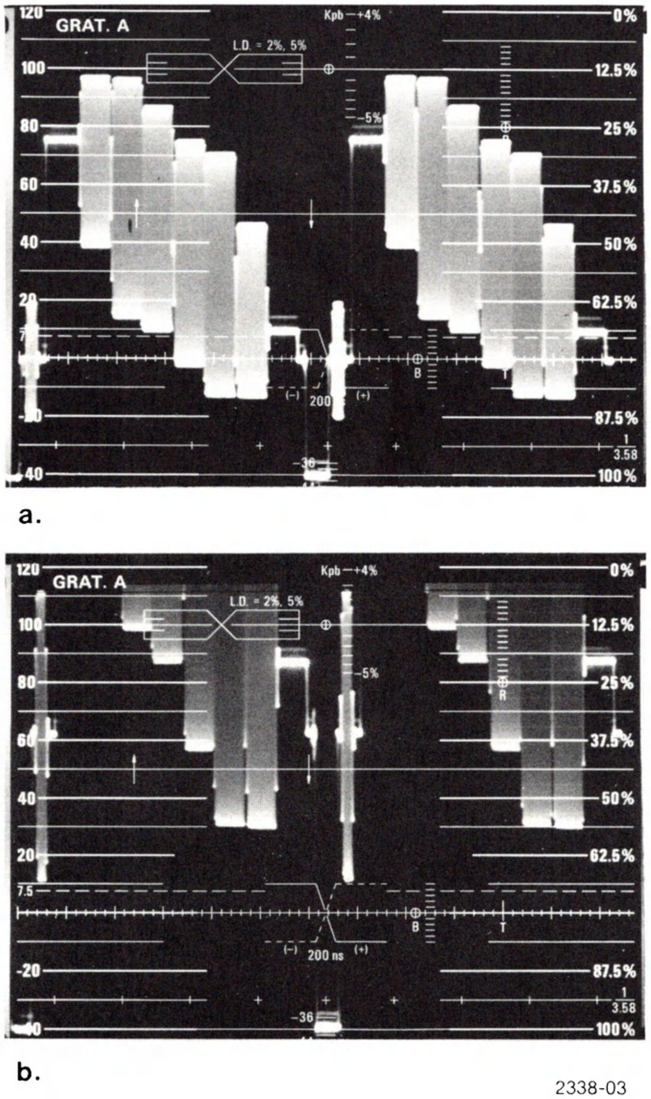
Fig. 1-3. Overlayed levels at sync tip.

2. Vertical Attenuation

Change VOLTS FULL SCALE to 0.5 and vertically position the display so that the sync pulse amplitude can be measured. It should be double the amplitude seen with the VOLTS FULL SCALE at 1.0.

Adjust the VAR VOLTS FULL SCALE for a sync pulse amplitude equal to that observed at 1.0 VOLTS FULL SCALE. Change VOLTS FULL SCALE to 0.2 and check for sync pulse amplitude 2.5 times greater than the amplitude set with the variable control. See Fig. 1-4.

Return VAR to its detented position and set the VOLTS FULL SCALE to 1.0.



2338-03

Fig. 1-4. Sync amplitude measurement, a. normal, b. 2.5X increased.

3. DC RESTORER

Depress the DC RESTORER OFF pushbutton and position the display so that the baseline is at the blanking level (300 mV or 0 IRE).

Push in the FAST DC RESTORER and note a rapid shift to a new average level.

Turn off the DC RESTORER (OFF).

Push in the SLOW DC RESTORER and note rapid shift followed by a slow change to a new average level.

Depress the SYNC TIP pushbutton and check for a change in the average level.

4. RESPONSE SWITCH

This step is written using a composite test signal; however, RESPONSE positions can be checked with any of the normally available test signals. Fig. 1-5a is an NTSC Composite Test Signal.

a. LOW PASS: Switch the RESPONSE to LOW PASS and note that all subcarrier and corners of fast transitions are lost. See Fig. 1-5b.

b. LUM or IRE: Switch the RESPONSE to LUM (IRE) and note that most subcarrier is lost but the corners of the fast transitions are retained. See Fig. 1-5c.

c. FLAT: Switch the RESPONSE to FLAT and note an undistorted presentation of the composite test signal, Fig. 1-5d.

d. BANDPASS (4.43 or 3.58): Switch the RESPONSE to BANDPASS and note that only the subcarrier information is presented. See Fig. 1-5e.

e. DIFF'D STEP: Switch the RESPONSE to DIFF'D STEP and note that each transition is now represented as a spike. See Fig. 1-5f.

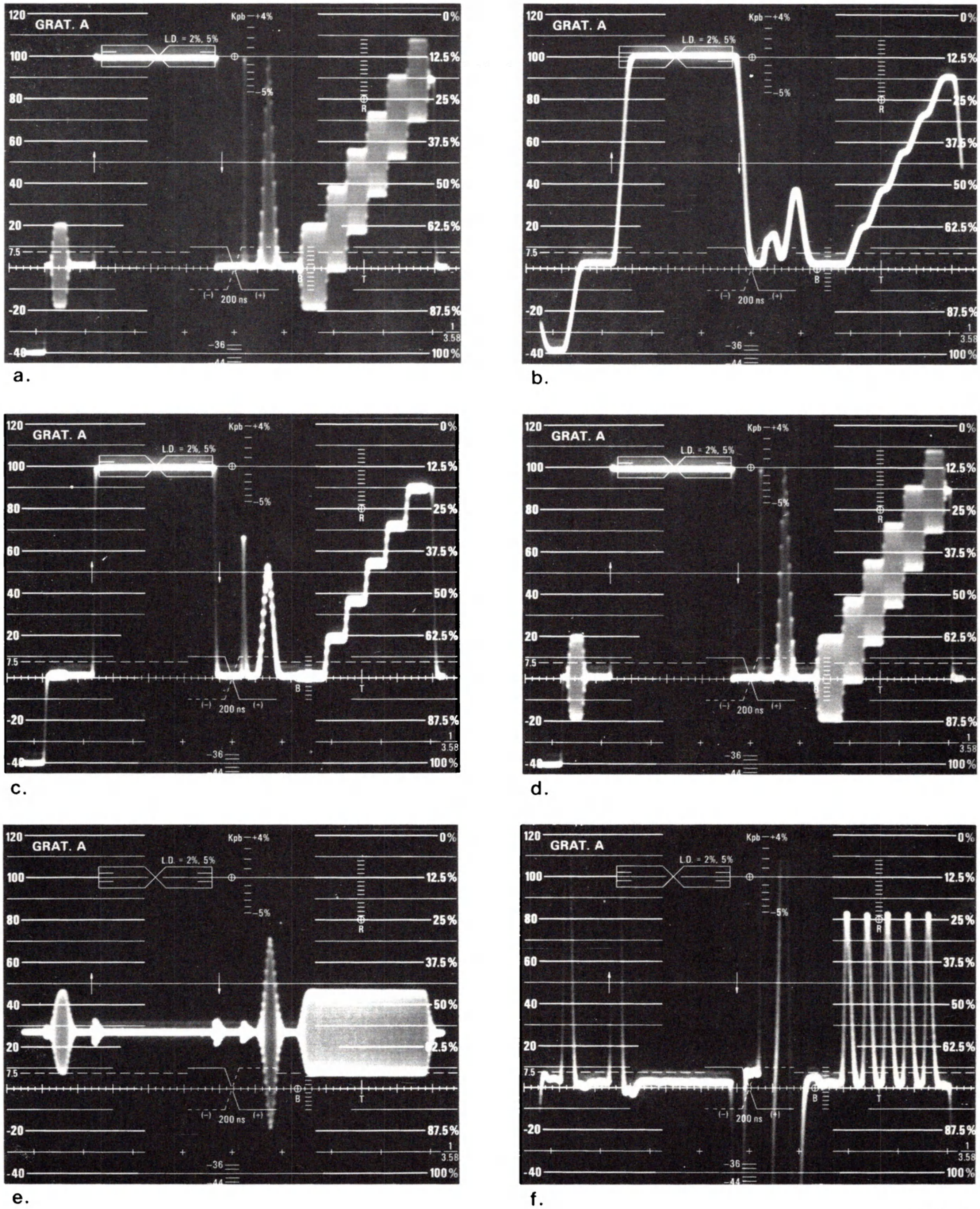


Fig. 1-5. Effects of the various filters on a Composite Test Signal. a. Applied signal, b. Low Pass filter, c. IRE (NTSC) or Lum (PAL), d. Flat, e. Bandpass, f. Diff'd Step.

5. WAVEFORM COMPARISON

Turn the larger (OVERLAY) knob out of the switch detent, note that the WAVEFORM COMPARISON light comes on.

Rotate the smaller (LOCATE) knob back and forth slowly and note a small break in the trace and moves back and forth with the rotation of the LOCATE knob. Position the break between the pulse and bar components of the composite test signal.

With the OVERLAY control, position the right side of the display so that the pulse lines up directly under the bar. See Fig. 1-6.

Return the OVERLAY control to the detented position.

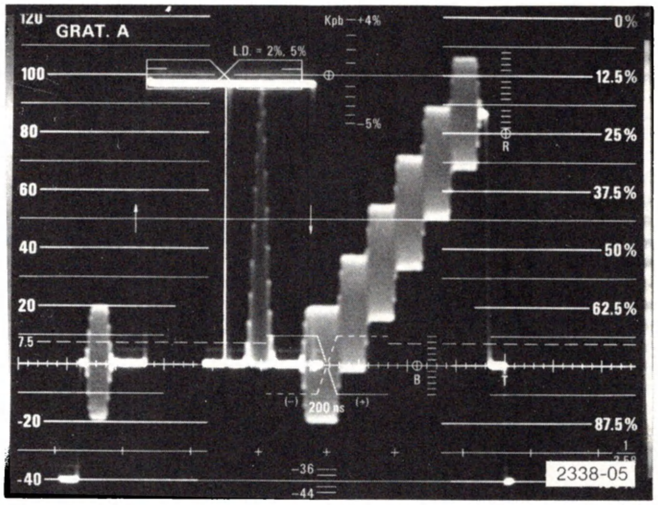
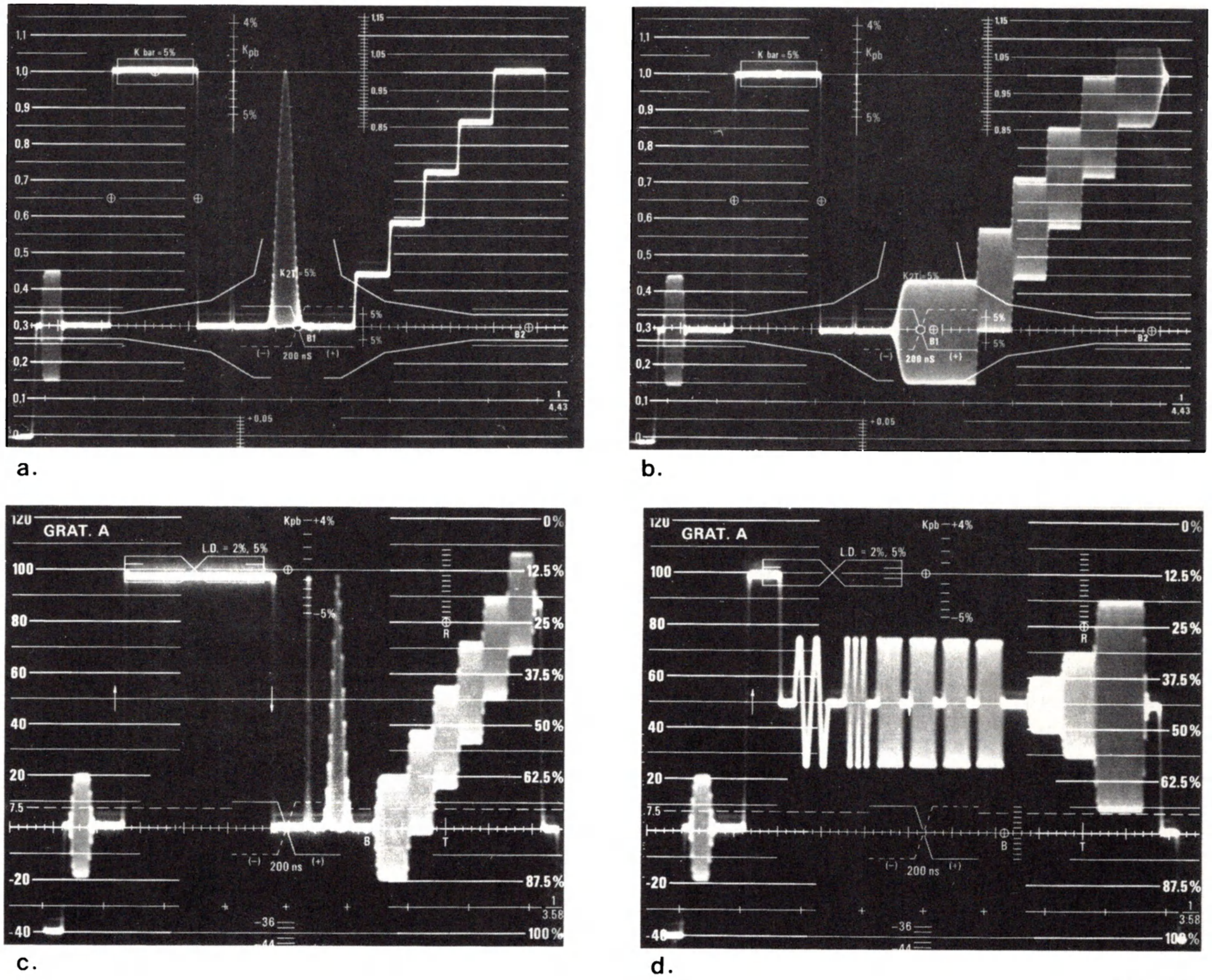


Fig. 1-6. Waveform Comparison overlayed pulse and bar signal.



a.

b.

c.

d.

2338-06

Fig. 1-7. Test Signals that can be found in the vertical interval. a. Line 17 International Test Signal (Europe), b. Line 330 International Test Signal (Europe), c. NTSC Composite Test Signal (Line 17, Field 1), d. NTSC Test Signal (Line 17, Field 2).

6. LINE SELECTOR

These tests require that the operator know on what vertical interval lines the test signals (VITS or ITS) have been inserted.

a. DIGital: Push the DIG and correct FIELD buttons, rotate the LINE SELECTOR switch until a line known to carry a test signal is selected. For example, line 17 or 330 in the PAL color system. Check that the test signal is correct for the field and line selected. See Fig. 1-7a through 17d.

b. VARiable: Depress the VAR pushbutton and rotate the VAR LINE SELECTOR through its range and check that both vertical interval and picture area line can be displayed.

c. 15 LINES: Push the 15 LINES button and rotate the VAR LINE SELECTOR from end to end and find a display that has picture information and vertical interval lines, including test signals. See Fig. 1-8.

d. ALL FIELDS: Push the DIG pushbutton and select line 17 (17 & 330). Depress the ALL FIELDS pair and observe overlayed test signals. See Fig. 1-9.

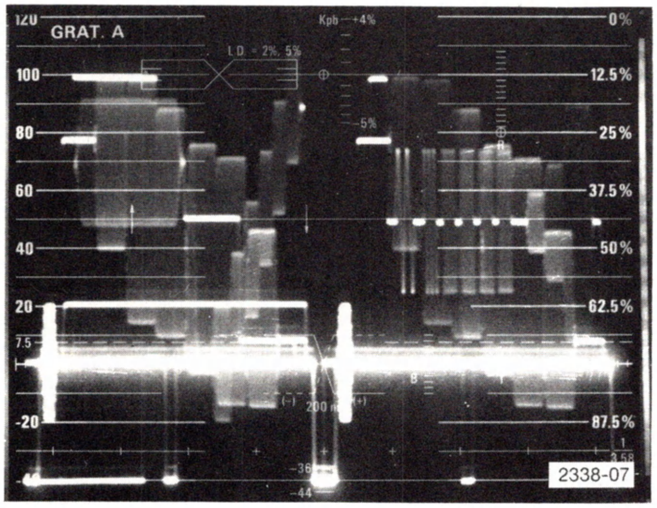
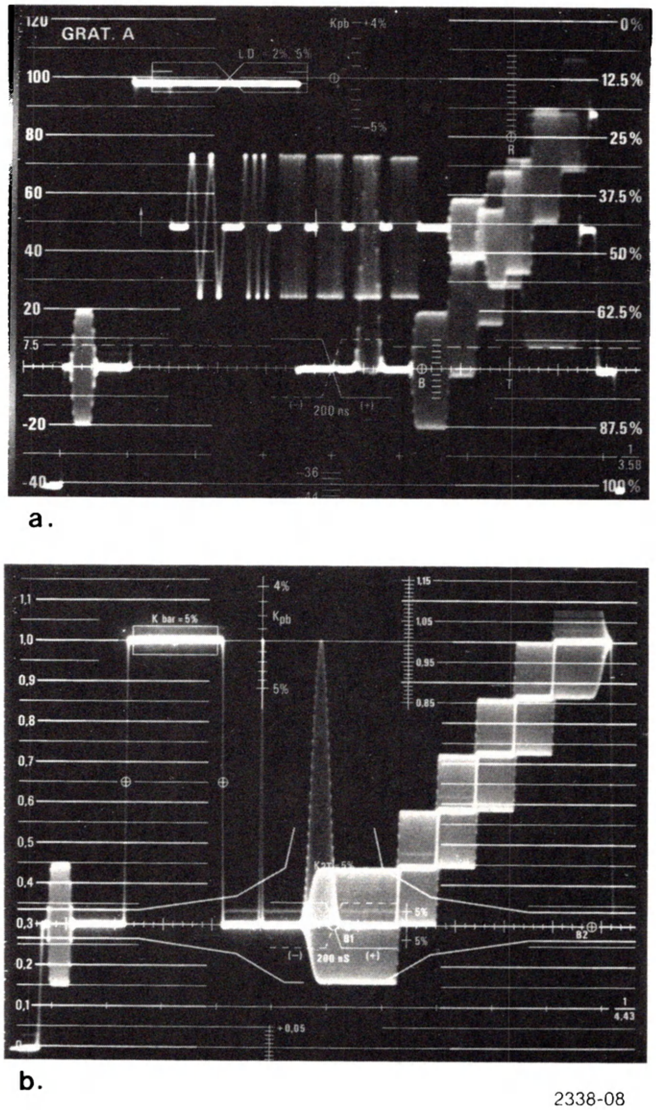

120
GRAT. A
Kpb —+4%
0%
L.D. = 2%, 5%
100
12.5%
80
-5%
25%
60
37.5%
40
50%
20
62.5%
7.5
(-) 200 ns (+)
-20
87.5%
1
3.58
-36
-44
2338-07

Fig. 1-8. 15-Line display with both active and vertical interval lines.


120
GRAT. A
Kpb —+4%
0%
L.D. = 2%, 5%
100
12.5%
80
-5%
25%
60
37.5%
40
50%
20
62.5%
7.5
(-) 200 ns (+)
-20
87.5%
1
3.58
-36
-40
100%
a.
1,1
1,0
0,9
0,8
0,7
0,6
0,5
0,4
0,3
0,2
0,1
K bar = 5%
4%
Kpb
5%
1,15
1,05
0,95
0,85
B1
B2
(-) 200 nS (+)
+0,05
1
4,43
b.

2338-08

Fig. 1-9. All Fields display of test signals that are inserted in the vertical blanking interval. a. NTSC line 17 both fields, b. PAL lines 17 and 330 (overlayed).

7. DISPLAY SELECTION

a. 2 FIELD: Change the DISPLAY to 2 FIELD. Depress the LINE SELECTOR OFF pushbutton. Check for a full 2-field display, including part of the first vertical interval. See Fig. 1-10.

b. 10 μs/DIV: Change the DISPLAY to 10 μs/DIV and check for a 2-line display. See Fig. 1-11.

c. 5 μs/DIV: Change the DISPLAY to 5 μs/DIV and check for a 1-line display. See Fig. 1-12.

NOTE

The EXTernal position of the 1480-Series DISPLAY switch is inactive (unless an internal circuit change is made); therefore, it is not looked at while these familiarization steps are performed.

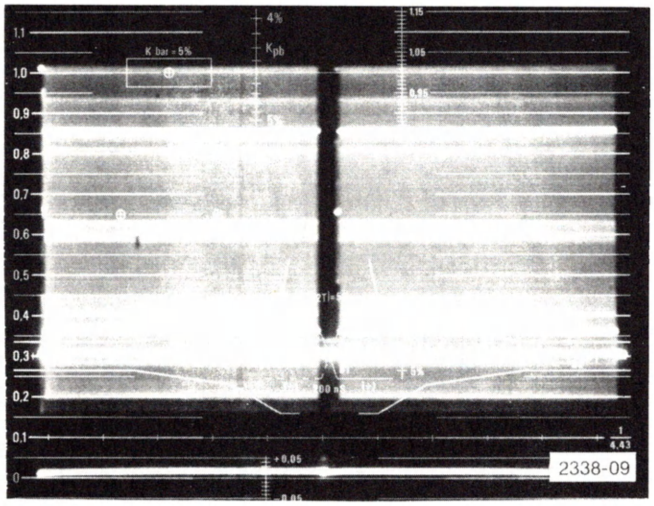

1,1
1,0
0,9
0,8
0,7
0,6
0,5
0,4
0,3
0,2
0,1
0
K bar = 5%
4%
Kpb
1,15
1,05
0,95
+0,05
-0,05
1
4,43
2338-09

Fig. 1-10. 2-field display.

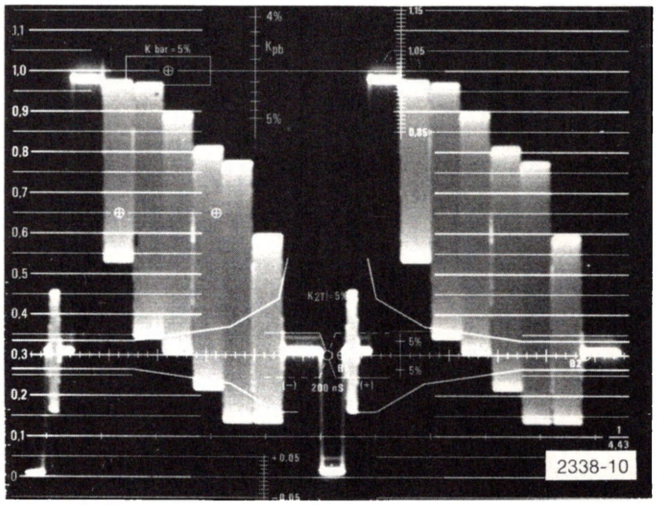

1,1
1,0
0,9
0,8
0,7
0,6
0,5
0,4
0,3
0,2
0,1
0
K bar = 5%
4%
Kpb
5%
1,15
1,05
0,85
K2T = 5%
200 nS
(-)
(+)
+0,05
-0,05
1
4,43
2338-10

Fig. 1-11. Two-line display of test signal, 10 μs/Division.

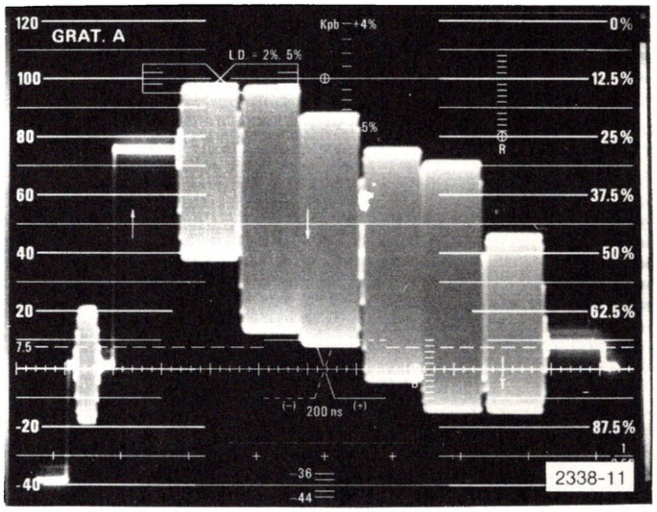
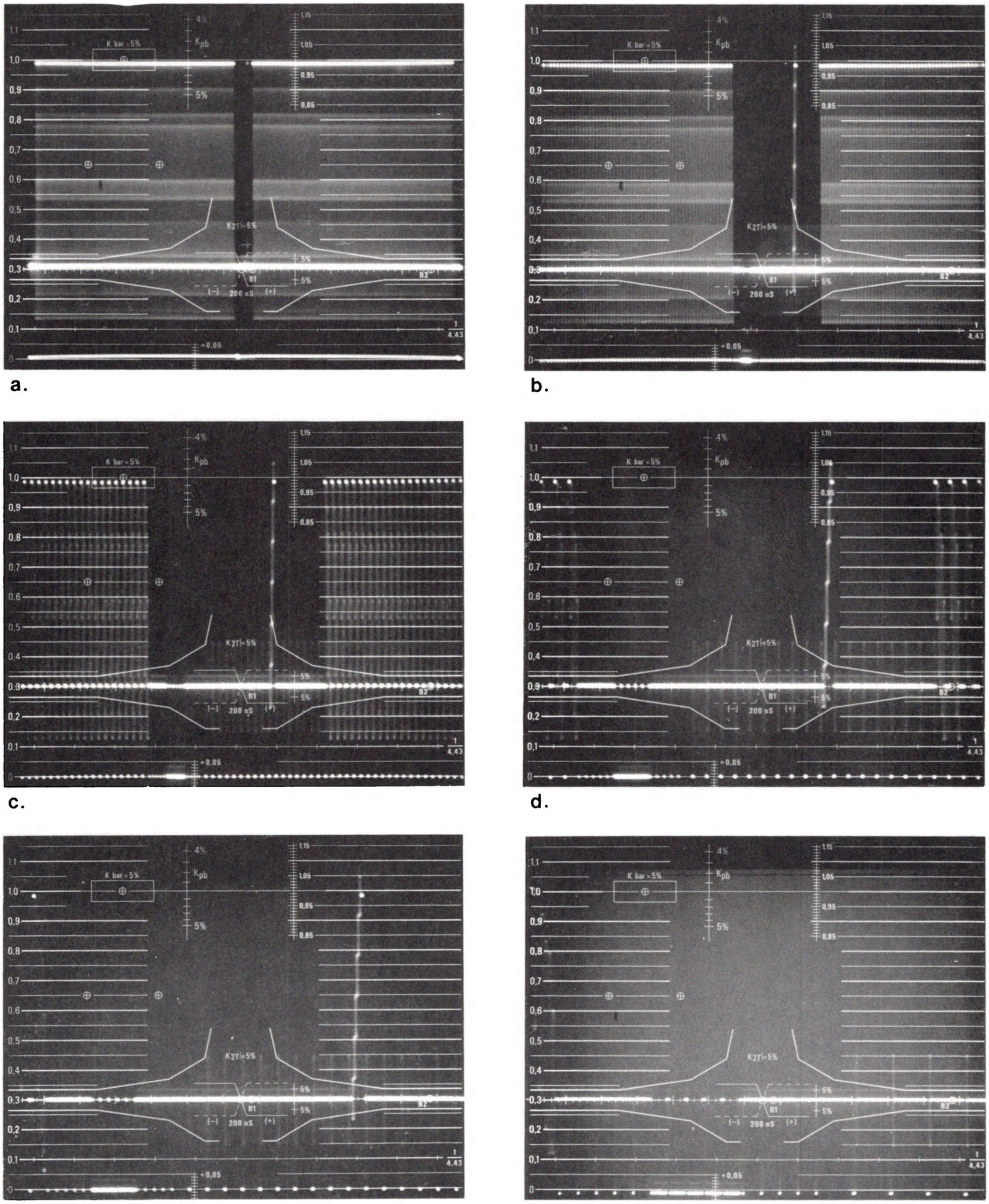

120
GRAT. A
100
80
60
40
20
7.5
-20
-40
Kpb = +4%
L.D. = 2%, 5%
5%
0%
12.5%
25%
37.5%
50%
62.5%
87.5%
R
(-)
200 ns
(+)
-36
-44
2338-11

Fig. 1-12. A one-line display of a test signal at 5 μs/Division.

8. MAGNIFIER

a. Fixed MAGNIFIER: Set the DISPLAY to 2 FIELD and the MAGNIFIER to 1, use the HORIZONTAL POSITION to place the vertical interval at graticule center. See Fig. 1-13a. Rotate the MAGNIFIER through its settings and check for a display similar to each of those in Fig. 1-13a through 1-13f.


1,1
1,0
0,9
0,8
0,7
0,6
0,5
0,4
0,3
0,2
0,1
0
K bar = 5%
Kpb
4%
5%
1,15
1,05
0,95
0,85
K2T = 5%
5%
B1
B2
(−) 200 nS (+)
1
4,43
+0,05

a.

b.

c.

d.

e.

f.

2338-12

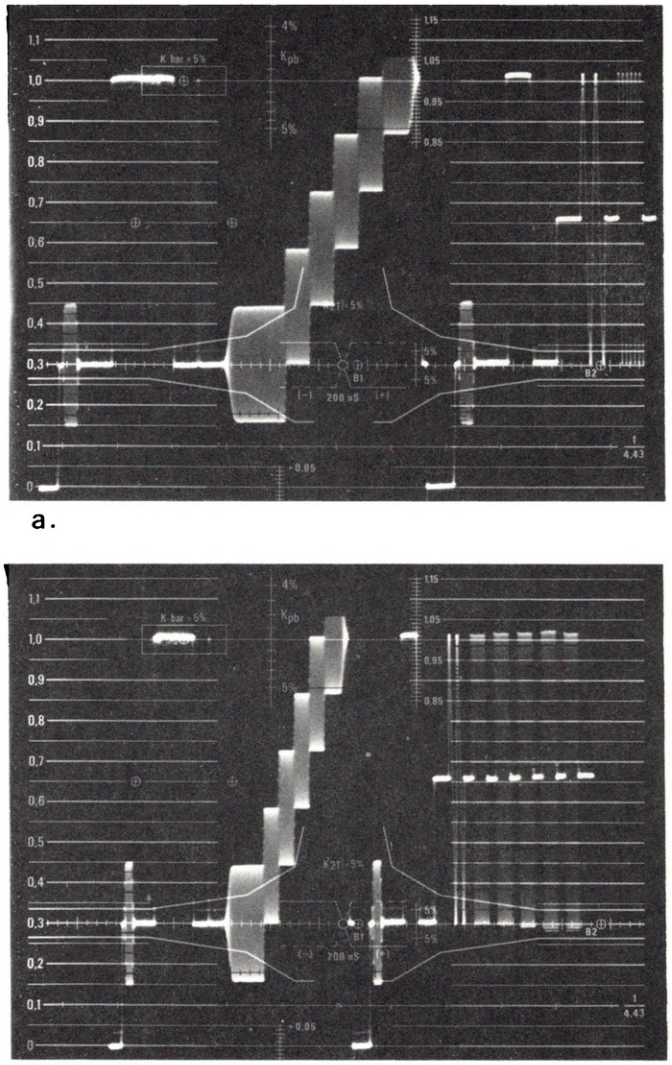
Fig. 1-13. Magnified Sweep a. X1, b. X5, c. X10, d. X20, e. X25, f. X50.

b. VARiable MAGNIFIER (1481, 1482, & 1485 only): Set the MAGNIFIER TO X1 and the DISPLAY to 10 μs/DIV. See Fig. 1-14. Rotate the VARiable MAGNIFIER back and forth to check its total range. Change in duration of one line from less than 1/2 scale/line to greater than 1/2 scale/line. See Fig. 1-14.

This procedure has only covered the standard instrument; if the instrument being looked at contains any options, it will be necessary to consult the Performance Verification Procedure (Section 5) for familiarization.

REPACKAGING INSTRUCTIONS

The 1480-Series shipping carton provides maximum instrument protection during shipment. If reshipment becomes necessary, repackaging the instrument in its original carton will minimize the danger of damage during shipment. Figure 1-15 and 1-16 show how to repackage the instrument.



a.

b.

2338-13

Fig. 1-14. Variable Magnifier (1481-1482-1485 only) a. Greater than 1, b. Less than 1.

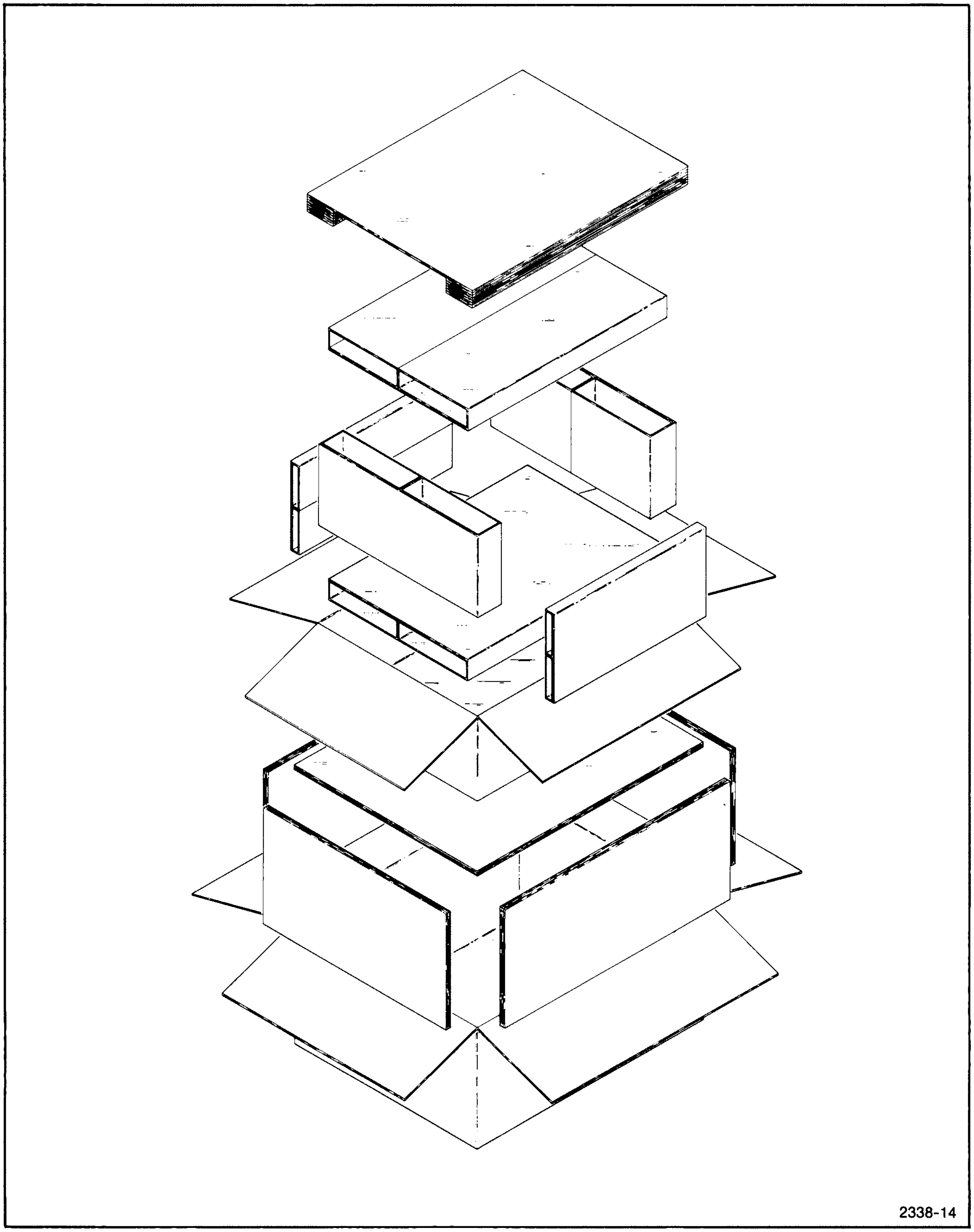


Fig. 1-15. 1480-Series Rackmount packaging.

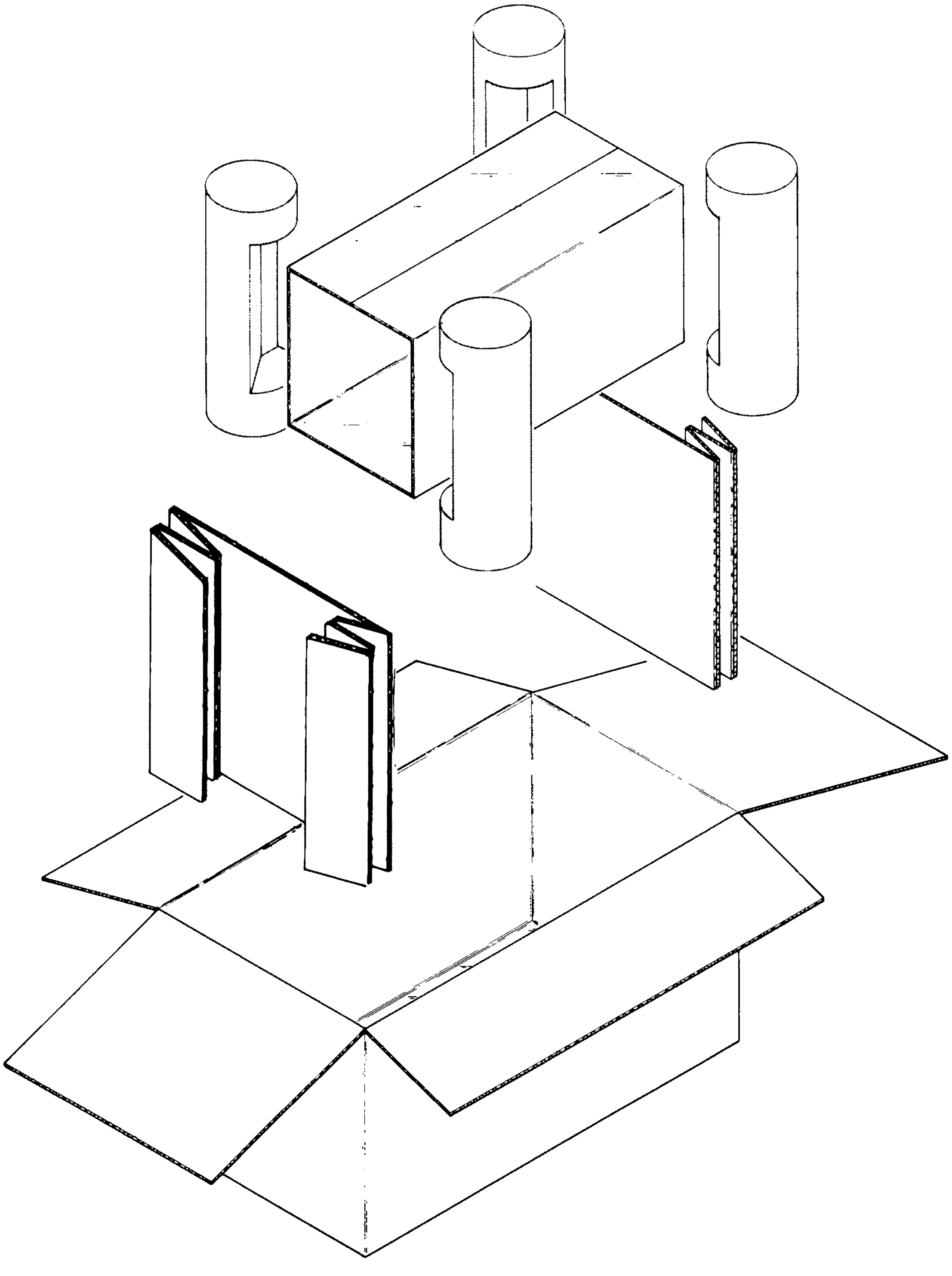


Fig. 1-16. 1480-Series Cabinet model packaging.

OPERATING INSTRUCTIONS

The 1480-Series of Television Waveform Monitors prove a combination of high performance and versatility. They can be single-standard models or dual-standard combinations, available for most of the world's operating television systems.

1480-Series are available in either cabinet or rackmount configurations, designed for use in control rooms, video tape installations or transmitter plants.

Many catalog options are available to closely tailor a 1480-Series Waveform Monitor to specific measurement applications.

FEATURES

Vertical

A distortion-free, vertical overscan capability offers increased high-resolution measurements. Coupled with a wide vertical positioning range, any portion of a nominal 1-volt composite video signal can be viewed at any position of the VOLTS FULL SCALE settings.

The vertical response can be specialized by selecting one of several filters from the front panel, ranging from LOW PASS, through IRE and FLAT, to BANDPASS around certain color subcarrier frequencies. In addition, the same switch can select a differentiated-steps display or an auxiliary video input at the rear panel.

A versatile DC Restorer offers clamping on the back porch or at the sync tip of the composite video waveform. Fast and slow clamping speeds can be selected to suit specific needs.

An internal calibration squarewave is available at the push of a button. This calibration signal can also be used to offset the displayed video signal for quick amplitude accuracy checks.

Catalog Option 1 provides an ac-coupled probe input to the vertical channel. Operating instructions are covered later in this section.

Horizontal

Calibrated magnification to X50 and a high writing-rate crt allow viewing of fast-rise, low repetition-rate signals such as the 100 ns risetime of a test signal on a single line out of the four fields in the PAL system. In high-magnification positions, the crt is automatically brightened.

"Timebase Foldback", a waveform comparision feature, provides for locating and overlaying a portion of a line-rate display with another portion of the same display. For instance, in measuring pulse-to-bar ratio, the pulse can be displayed directly beneath the center of the bar.

The horizontal display can be any of the following:

1) Digitally-selected line (or two lines, depending on sweep speed selected.)

2) Continuously variable selection of line (or two lines).

3) 2 fields (fields 1 and 3 or 2 and 4 for NTSC).

4) One brightened line from 2 fields (or two brightened lines).

5) 15 lines—either brightened (from 2 fields) or superimposed on one another at line rate. Continuously-variable selection of the 15-line group is provided.

6) (Option 7 only). Slow Sweep (4 to 12 seconds/sweep).

7) All fields—permits simultaneous viewing of one line (or a group of lines) from each field.

8) External—signal at external horizontal input is displayed. (This mode is normally shipped disabled to avoid burning the cathode-ray tube. An internal jumper must be moved to enable. See note on diagram 9.)

Direct-acting Sync follows horizontal jitter, so that jitter is not displayed; the AFC mode displays any horizontal jitter.

Rear Panel

The main video and external sync signal inputs are of loop-thru design (no internal termination) and can be isolated from the chassis, allowing for differential rejection of hum by the input stages. Input connectors are available for RGB displays and external horizontal inputs along with an auxiliary video input to the vertical amplifier. Output connectors supply auxiliary video out, a picture monitor video signal, and a line strobe pulse coincident with the setting of the Line Selector Variable control, and the digital Line Selector.

Also available is a connector mounting location for customized, remote-operating installation.

Graticules

The graticule most applicable in the television system for which a particular model is intended is supplied internal to the crt. Also included as standard accessories are several external graticules, usually intended for specific measurements, or to convert dual-standard models from one line standard to the other. A blank crt is available as an option.

External graticules are available in both NTSC and CCIR configurations in two pattern sizes. One, intended for normal viewing use, is the same pattern size as the internal graticule.

The second pattern size is slightly smaller than the internal pattern and is designed to remove parallax effects when using an oscilloscope camera.

CONTROLS

Some of the pushbuttons on the front panel are color-coded dark gray. With all these buttons pushed in, the waveform monitor display will be normal according to the vertical response mode selected. All pushbuttons have functional labels. Within their own groups, the buttons are self-cancelling when pushed individually. In certain operating modes, the OPER and CAL button-pair will be pushed in at the same time, as well as pairs of the FIELD buttons.

Almost all of the functions, controls, connectors, and indicators needed and used by any of the models in the series are present on the 1485 NTSC/PAL dual-standard instrument. Therefore, the 1485 is used as the example to illustrate and describe the features of the 1480-Series of Waveform Monitors.

Controls listed in the following are referenced to Fig. 2-1.

1. POWER—Applies or removes mains voltage to the power transformer primary.

2. POWER ON—Lights to indicate presence of mains voltage at power transformer primary.

3. SIGNAL—Lights indicate 50 Hz or 60 Hz field-rate input signal. (1485 only).

4. INPUT—Selects A or B VIDEO INPUTS, or A-B differentially, ac or dc coupling, and the X10 PROBE INPUT if the waveform monitor is equipped with Option 1.

5. VOLTS FULL SCALE—Alters vertical gain allowing 1.0, 0.5, or 0.2-volt signals to produce full screen deflection. Also acts as a vertical magnifier providing X2, or X5 expansion of the input signal.

6. VAR VOLTS FULL SCALE—Varies vertical gain from X0.5 to X1.4 nominal (−6 dB to +3 dB) when not in the CAL detent position.

7. UNCAL—Lights up to indicate the VAR VOLTS FULL SCALE control is not in CAL.

8. RESPONSE—Selects wide-band, filtered, or differentiated vertical response modes. Also selects auxiliary video input from rear panel.

LOW PASS: Attenuates frequencies 500 kHz and up by at least 14 dB (−40 dB at 1 MHz typical).

IRE: Conforms to IRE standard 23S-A, 1958 (−22 dB at 4.43 MHz typical). 1480C and 1480R only.

FLAT: Unfiltered, wide-band position. Flat to 5 MHz or more, −3% at 10 MHz.

4.43 BANDPASS: Provides bell-shaped response curve with 4.43 MHz as center frequency. Within 1% of FLAT reference at 4.43 MHz.

3.58 BANDPASS: Provides bell-shaped response curve with 3.58 MHz as center frequency. Within 1% of FLAT reference at 3.58 MHz.

DIFF'D STEP: Differentiates risers of linearity test signals, providing amplitude comparisons of staircase step risers. Automatically increases vertical gain to maximum (between 5 and 7 times). Attenuation increases from about −2 dB at 0.5 MHz to about −40 dB at color subcarrier center frequencies. Dc restoration not effective in this mode.

AUX VIDEO IN: Provides unfiltered, wide-band input to the vertical amplifier. The response characteristics are the same as FLAT.

9. DC RESTORER—Eliminates vertical drift and provides stable displays despite changes in signal amplitude and average luminance levels. Buttons select the clamping speed and clamping location on the composite video signal. In the DIFF'D STEP response mode, the dc restoration is automatically turned off. In the LOW PASS response mode, SYNC TIP is automatically locked out. In the BANDPASS response modes, the dc restorer circuits still operate, but, because the filters do not pass dc or a low-frequency component, dc restoration neither adds to, nor detracts from, measurements made with these filters.

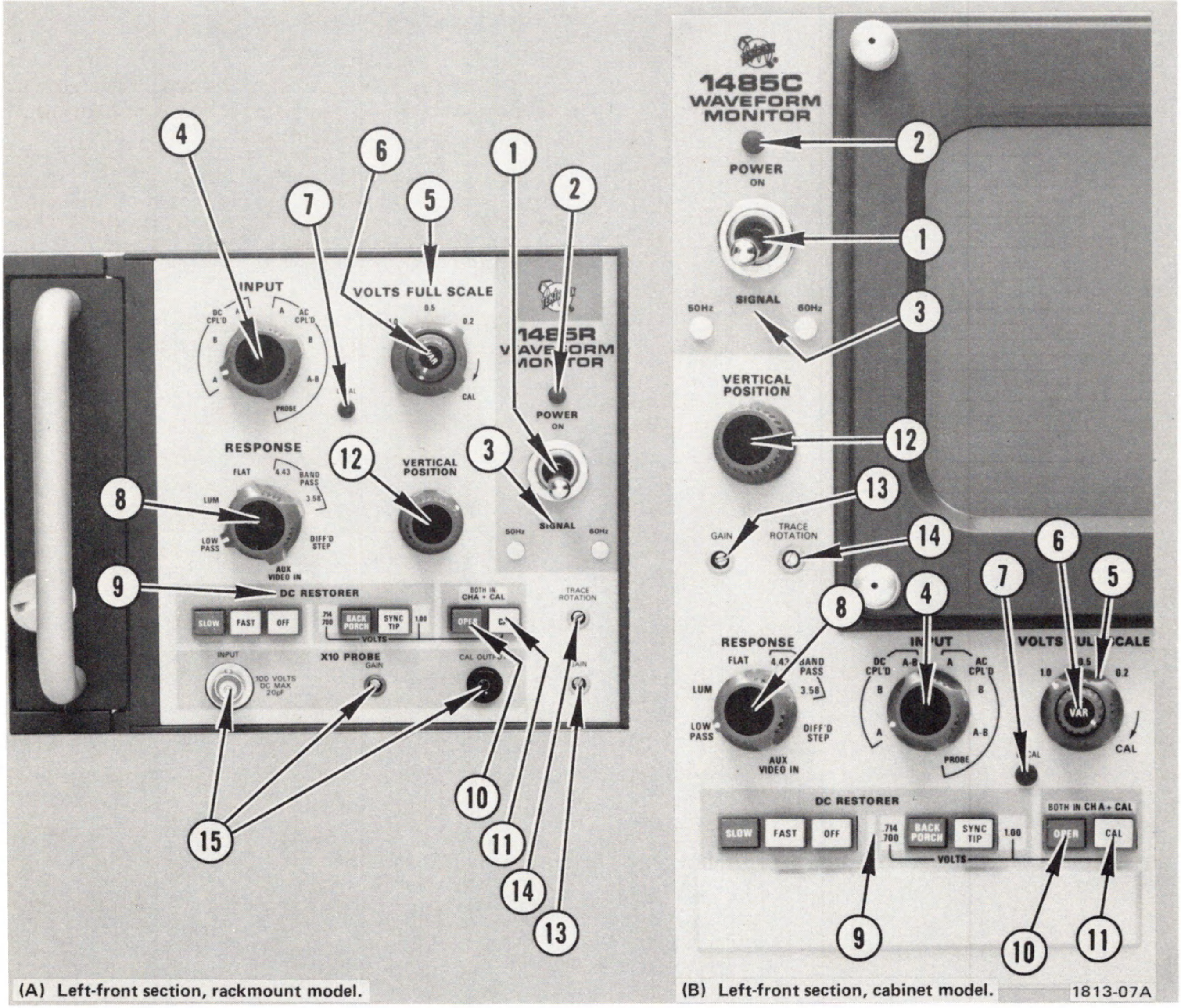
OFF: Disables the dc restoration circuits. The trace level will follow the dc content of the incoming signal.

SLOW: Selects a time-constant long enough to display mains hum and field-rate tilt in the video signal.

FAST: Selects instantaneous clamping to eliminate hum and tilt in the display. Attenuates mains hum at least −26 dB.

BACK PORCH: Sets the clamping sample pulse to occur at back-porch time in the composite video waveform.

SYNC TIP: Sets the clamping sample pulse to occur at sync-tip time in the composite video waveform.


4
6
1
7
5
2
INPUT
VOLTS FULL SCALE
1485R WAVEFORM MONITOR
POWER ON
RESPONSE
FLAT
BAND PASS
LUM
LOW PASS
DIFF'D STEP
AUX VIDEO IN
VERTICAL POSITION
SIGNAL
50Hz
60Hz
DC RESTORER
SLOW
FAST
OFF
BACK PORCH
SYNC TIP
VOLTS
BOTH IN CHA + CAL
OPER
CAL
TRACE ROTATION
X10 PROBE GAIN
CAL OUT
GAIN
100 VOLTS DC MAX 20pF
8
9
12
3
10
11
14
13
15
1485C WAVEFORM MONITOR
PROBE
VAR
CAL

(A) Left-front section, rackmount model.

(B) Left-front section, cabinet model.

1813-07A

Fig. 2-1. Vertical control locations for rackmount, left, and cabinet model, right.

10. OPER—Selects the INPUT signal for normal display operation.

11. CAL—Selects an internally-generated squarewave useful for checking vertical gain and the complete or component parts of a composite video signal.

When CAL is pushed in at the same time as the OPER button, the incoming signal (at the A Input only) is overlayed on the two levels of the calibrator squarewave for quick and accurate evaluation of the video signal amplitude.

The Calibrator signal amplitude is dependent on the DC Restorer settings; Sync Tip 1 V; Back Porch 700 mV or 714 mV, depending further on which line-standard external graticule is being used.

12. VERTICAL POSITION—Provides positioning in the vertical direction with a ten-turn potentiometer.

13. GAIN—Adjusts amplitude of the displayed signal with the VARiable VOLTS FULL SCALE control in the CALibrated (detent) position. This is usually adjusted by comparing the internal calibrator signal with the calibrated internal graticule.

14. TRACE ROTATION—Aligns the display with the horizontal graticule lines.

15. OPTION 1

X10 PROBE INPUT—Bnc connector for use with an external high-impedance, X10 probe. Input amplifier has a gain of 10X to compensate for the probe's attenuation; a one-volt signal through the X10 probe will appear as one volt on the crt.

X10 PROBE GAIN—Adjusts the gain of the probe amplifier.

X10 PROBE CAL OUTPUT—When the CAL pushbutton is depressed, a 1 V calibrator signal, for compensating the X10 probe, is available.

Controls listed in the following are referenced to Fig. 2-2.

16. DISPLAY—Selects the calibrated sweep rates, and horizontal input mode in standard instruments. In instruments that contain Option 7, the DISPLAY switch has two extra positions, Slow Sweep −Polarity and Slow Sweep +Polarity.

2 FIELD: Displays two fields at 25 Hz or 30 Hz frame rates. Sweep starts at line 16 of the vertical interval of the field or field-pair selected by FIELD switch.

10 μs/DIV: Selects sweep rate to effectively display two line periods of either 525-line or 625-line systems (The graticule horizontal scale is marked for 12.7 div or 127 μs. In 525-line systems, a two-line period equals 127 μs; in 625-line systems a two-line period equals 128 μs.

5μs/DIV: Selects sweep rate to effectively display one line-period of either system.

EXT: Selects the external horizontal input for display.

Normally shipped disabled to protect the cathode-ray tube. Internal wiring change is required to activate.

SEE NOTE ON DIAGRAM ⟨9⟩

OPTION 7

SLOW SWEEP ± TRIG PLRT—Selects Slow Sweep and the triggering polarity for sweep origin.

SLOW SWEEP VAR—Controls slow sweep rate over a range of approximately 4 to 12 seconds/sweep. Whenever slow sweep is selected and the trace is not on the screen, a red indicator lamp, that is part of the Waveform Comparison circuit, will be lit.

17. MAG μs/DIV—Overrides DISPLAY switch to select other sweep deflection factors. Display brightness is automatically increased to maintain balanced displays.

OFF: Selects normal sweep modes controlled by DISPLAY switch.

X5, X10, X20, X25, X50: Magnifies 2 FIELD and EXTernal displays accordingly.

1, .5, .25, .2, .1: Overrides 10 μs/DIV or 5 μs/DIV modes to provide indicated calibrated sweep speeds.

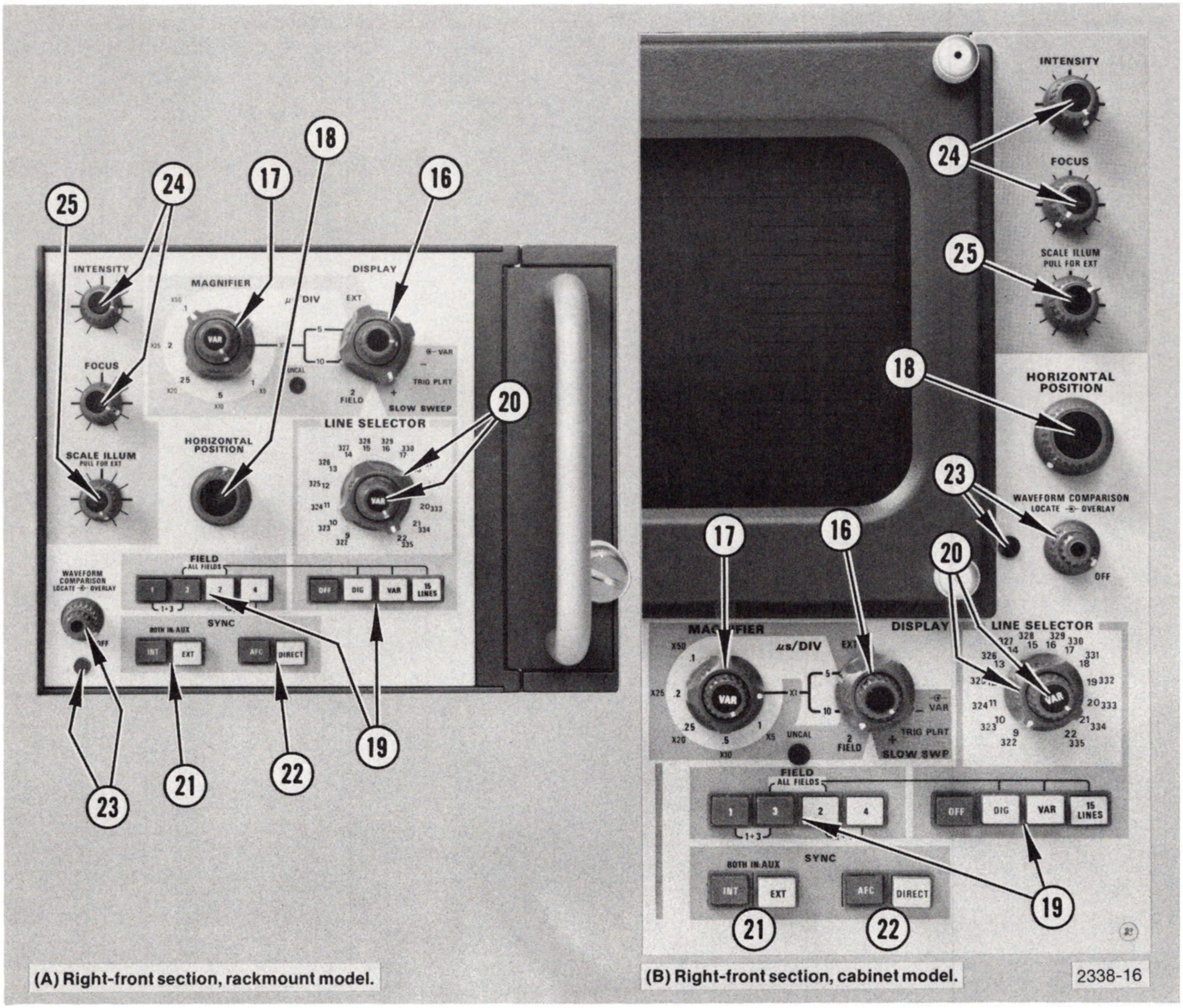
VAR (1481, 1482, and 1485 only)—Extends the effective range of the fixed magnifier positions.

18. HORIZONTAL POSITION—Moves display horizontally with a ten-turn potentiometer. This has sufficient range to display both ends of the sweep at 50 times magnification.

19. FIELD—Positively selects the beginning of the 2 FIELD sweep. Buttons select individual fields 1, 2, 3, or 4 for PAL systems, or EVEN (fields 1 and 3) or ODD (fields 2 and 4) field pairs for NTSC systems.

Simultaneously pressing FIELD 3 and 2 buttons and any LINE SELECTOR function selects all fields to be time overlaid.

During the ALL FIELDS mode, the horizontal sweep is only one field-period long. The LINE SELECTOR VARiable control cannot be used to select lines or groups of lines that belong in the second field of a normal 2 FIELD display.


18
17
16
24
25
INTENSITY
MAGNIFIER
DISPLAY
µs/DIV
VAR
EXT
FOCUS
UNCAL
2 FIELD
TRIG PLRT
SLOW SWEEP
20
LINE SELECTOR
SCALE ILLUM
PULL FOR EXT
HORIZONTAL POSITION
WAVEFORM COMPARISON
LOCATE -⊕- OVERLAY
OFF
FIELD
ALL FIELDS
1
3
2
4
1+3
OFF
DIG
VAR
15 LINES
SYNC
BOTH IN AUX
INT
EXT
AFC
DIRECT
19
21
22
23

(A) Right-front section, rackmount model.

(B) Right-front section, cabinet model.

2338-16

Fig. 2-2. Horizontal control locations for rackmount, left, and cabinet model, right.

20. LINE SELECTOR—Provides three modes of line selection to view any line in any field. The line or lines selected are intensified in the 2 FIELD display. The dark gray OFF button turns the LINE SELECTOR off.

DIG: Provides positive, digitally-controlled line selections from the vertical interval of selected fields to start the line-rate sweeps. Selects the ninth through the twenty-second line of each field.

VAR: Selects single lines from the displayed fields with a multi-turn potentiometer. While in the 2 FIELD mode, the selected line is intensified by a bright-up strobe. When the DISPLAY switch is set to 10 μs/DIV or 5 μs/DIV, the display starts with the selected line.

15 LINES: Performs the same as the VARiable mode except the strobe is fifteen lines wide. In the line-rate displays, the selected fifteen lines are overlaid on each other. This is used to display head rotation of a quad-head video tape recorder.

21. IN-EXT SYNC—Selects source for Horizontal Syncronization.

INT: Derives sync information from incoming video signal that is being displayed.

EXT: Derives sync information from composite signals applied to the rear panel (A) or (B) input.

22. AFC-DIRECT SYNC—Selects sync processing.

AFC: Phase-locks the internal oscillator to incoming line sync. This mode offers more noise immunity (about 8 dB jitter-reduction) than direct. However, jitter present in the signal can be seen more readily in AFC mode.

This mode displays every line of incoming video, including those with missing sync pulses (at least ten consecutive lines before loss of lock). As long as the incoming line frequency is within 200 Hz of 15,750 Hz, the phase-locked loop will provide a stable display. Otherwise, the sweep free-runs.

DIRECT: Provides a triggered display for every sync pulse received. This mode will operate on low rep-rate signals and up to 20 kHz line frequencies.

This mode will not display lines with missing sync pulses. After a long period of time without a trigger reference, sweep control will revert to the internal oscillator and free-run until a new sync pulse arrives.

23. WAVEFORM COMPARISON—Selects a time-overlay mode in the 10 μs/DIV and 5 μs/DIV sweep rates, useful for comparing most amplitudes within complex waveforms.

LOCATE: Positions the comparison break-point on the 10 μs/DIV and 5 μs/DIV displays, provided that the OVERLAY control is out of the OFF (detent) position. The comparison break-point, a small gap in the trace, will be positioned at the right side of the sweep when the LOCATE control is near its clockwise end.

OVERLAY: Time-overlays that portion of the sweep occuring after the break-point with the preceding part of the sweep. As the control is rotated counterclockwise, the display will overlay from right to left.

A red indicator turns on when the OVERLAY control is active.

24. INTENSITY & FOCUS—Control brightness of the beam and definition of the display.

25. SCALE ILLUM—Adjusts illumination of the internal or external graticule markings.

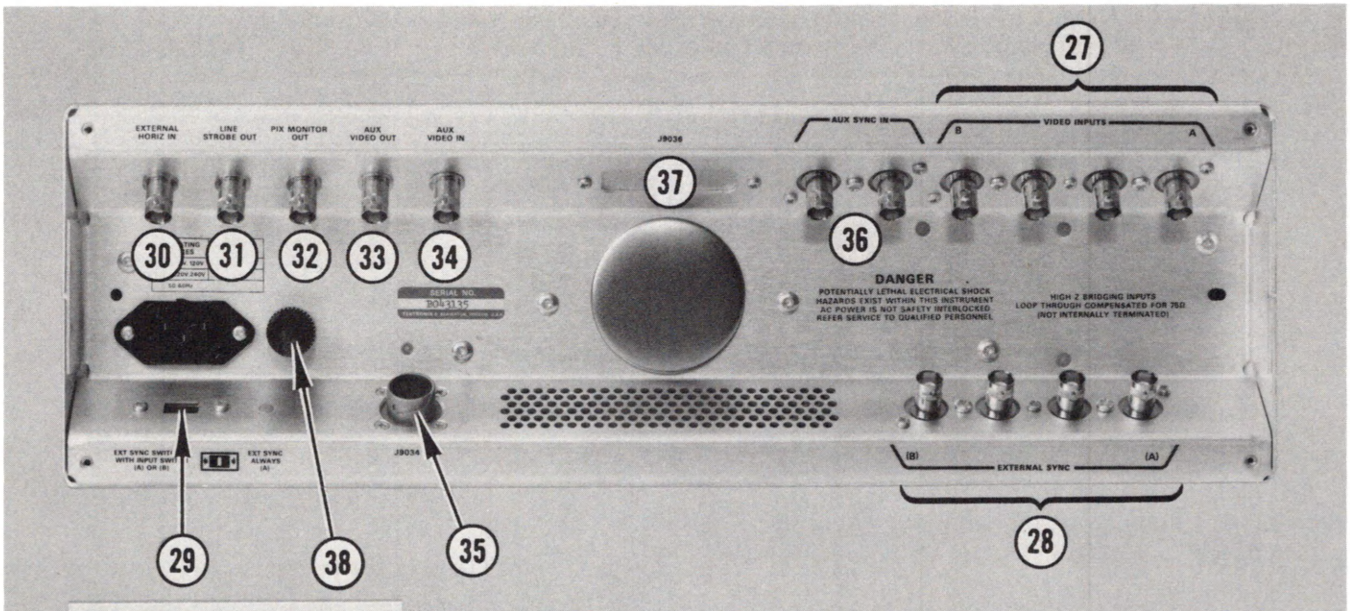
PULL FOR EXT: Selects lighting system for external graticules and turns off internal graticule system.

It also selects the calibrator waveform amplitude for the BACK PORCH mode of the DC RESTORER. The external graticule restrains a slide switch at its base, behind the bezel, to selecting the appropriate calibration voltage.

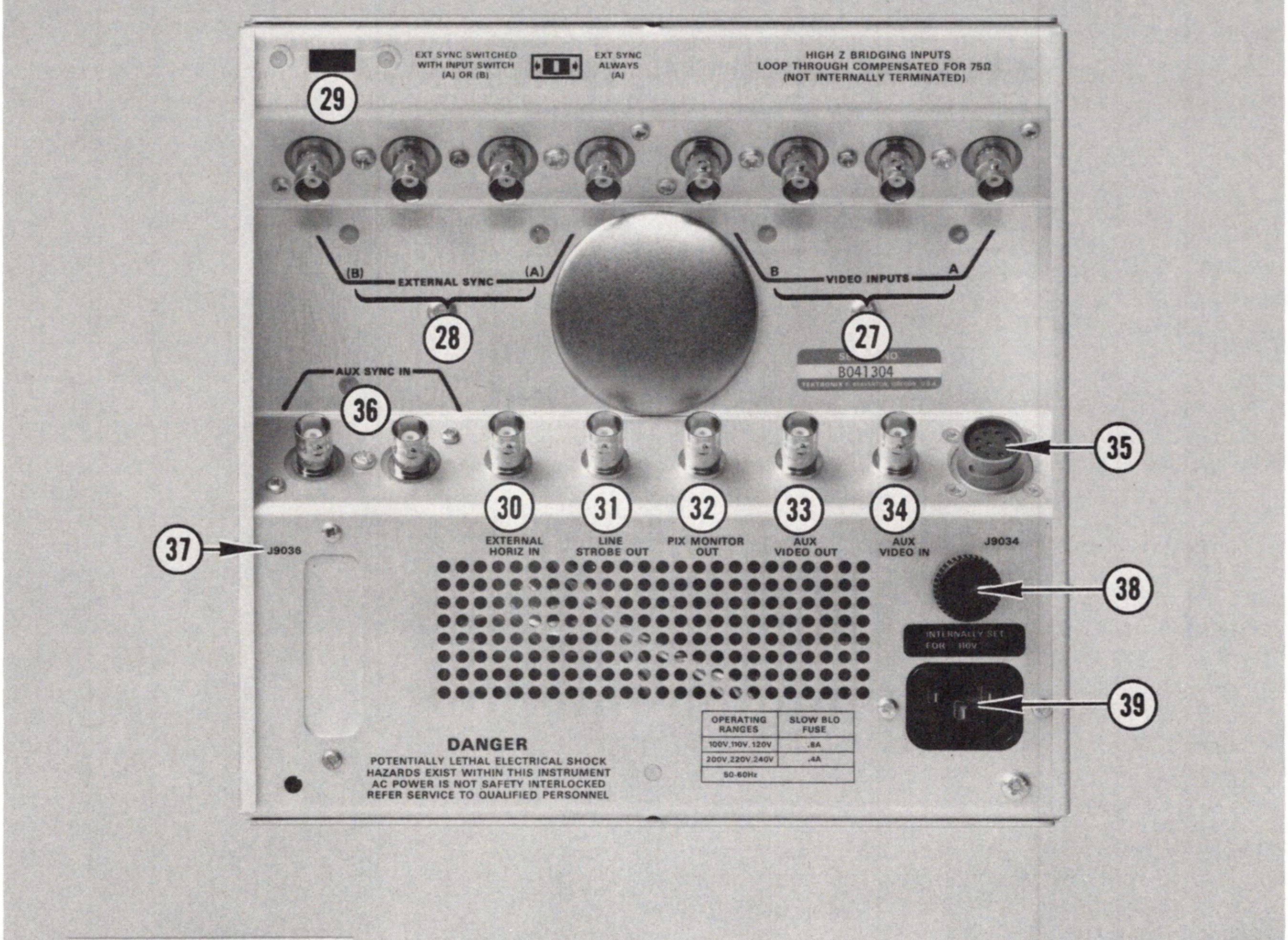
CONNECTORS

The following is a discussion of the various input and output connectors. In addition there are other features that are incorporated in the rear-panel configuration; they too are discussed here. All items mentioned are found in Fig. 2-3.

27. VIDEO INPUTS A & B—High impedance, loop-thru inputs for composite video. Compensated for 75 Ω, not internally terminated.


EXTERNAL HORIZ IN
LINE STROBE OUT
PIX MONITOR OUT
AUX VIDEO OUT
AUX VIDEO IN
J9036
AUX SYNC IN
VIDEO INPUTS
B
A
DANGER
POTENTIALLY LETHAL ELECTRICAL SHOCK HAZARDS EXIST WITHIN THIS INSTRUMENT AC POWER IS NOT SAFETY INTERLOCKED REFER SERVICE TO QUALIFIED PERSONNEL
HIGH Z BRIDGING INPUTS LOOP THROUGH COMPENSATED FOR 75Ω (NOT INTERNALLY TERMINATED)
SERIAL NO.
B043135
EXT SYNC SWITCHED WITH INPUT SWITCH (A) OR (B)
EXT SYNC ALWAYS (A)
J9034
(B)
EXTERNAL SYNC
(A)
27
28
29
30
31
32
33
34
35
36
37
38

(A) Rackmount model rear panel.


EXT SYNC SWITCHED WITH INPUT SWITCH (A) OR (B)
EXT SYNC ALWAYS (A)
HIGH Z BRIDGING INPUTS LOOP THROUGH COMPENSATED FOR 75Ω (NOT INTERNALLY TERMINATED)
(B)
EXTERNAL SYNC
(A)
B
VIDEO INPUTS
A
SERIAL NO
B041304
AUX SYNC IN
EXTERNAL HORIZ IN
LINE STROBE OUT
PIX MONITOR OUT
AUX VIDEO OUT
AUX VIDEO IN
J9036
J9034
INTERNALLY SET FOR 110V
OPERATING RANGES
SLOW BLO FUSE
100V,110V,120V
.8A
200V,220V,240V
.4A
50-60Hz
DANGER
POTENTIALLY LETHAL ELECTRICAL SHOCK HAZARDS EXIST WITHIN THIS INSTRUMENT AC POWER IS NOT SAFETY INTERLOCKED REFER SERVICE TO QUALIFIED PERSONNEL
27
28
29
30
31
32
33
34
35
36
37
38
39

(B) Cabinet model rear panel.

2338-17

Fig. 2-3. Rear panel connectors and features for 1480-Series rackmount and cabinet models.

28. EXTERNAL SYNC (A) & (B)—High impedance, loop-thru inputs for composite sync. Compensated for 75 Ω, not internally terminated.

29. External Sync Selector Switch—Selects source for external sync information.

EXT SYNC SWITCHED WITH INPUT SWITCH (A) OR (B): External sync input follows setting of the front-panel INPUT switch.

EXT SYNC ALWAYS (A): External sync input is always from the (A) input, regardless of the INPUT switch setting.

30. EXTERNAL HORIZ IN—Requires a 5-volt, positive-going input signal, starting at 0 volt, for full-screen deflection. Dc-coupled. Input impedance is 10 kΩ. No crt blanking.

Normally shipped disabled to protect the cathode-ray tube. Internal wiring change is required to activate this mode. See note on diagram 9.

31. LINE STROBE OUT—A line selector strobe pulse that is present only during Line Selector mode of operation.

32. PIX MONITOR OUT—A composite video output of incoming video signal, picked off after the vertical preamp, but before the Response filters. Line Strobe is added to the output signal in Line Selector modes of operation. Internally terminated in 75 Ω.

33. AUX VIDEO OUT—Same as PIX MONITOR OUT, except that the Line Strobe pulse is not available. Internally terminated in 75 Ω.

34. AUX VIDEO IN—Video input, internally terminated in 75 Ω. 1.5 dB gain allows for loss of passive networks that may be used. Enters the vertical system after the Response filters.

35. J9034—RGB input connector providing external switching control and signal access for RGB/YRGB displays.

36. AUX SYNC IN—This input is used in Options 4,5, and 7. An uncompensated loop-thru input used for either tone wheel sync input (Options 4 and 5) or the 50-60 Hz triggering signal (Option 7).

37. J9036—Blanking mounting location for possible remote control connector.

38. Main Fuse and Holder

39. Motor Base connector Receptacle—3-bladed connector to receive power cord. Contains an RFI filter.

GRATICULES

Patterns

Two basic patterns appear as 1480-Series internal graticules. They are the 625 line/50 Hz, K-Factor CCIR Composite combination (shown in Fig. 2-4) and a 525 line/60 Hz, Composite graticule, designated Graticule A, Fig. 2-5. Both of these patterns are available in external graticules in full scale and a 3% reduced photo version.

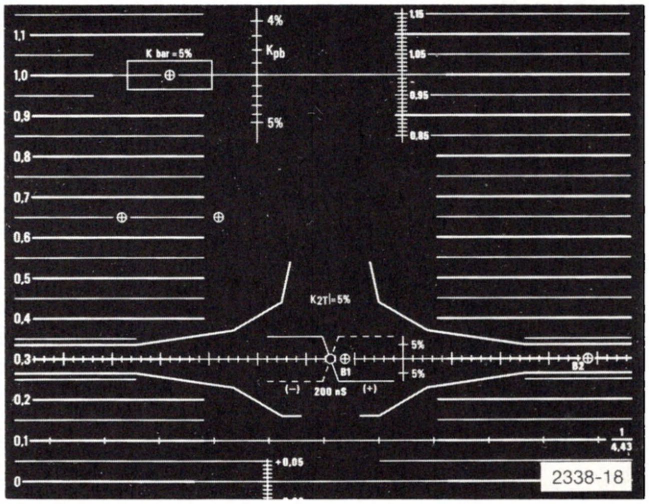


Fig. 2-4. CCIR Composite, K-Factor combination graticule supplied with 1480-Series 625/50 instruments.

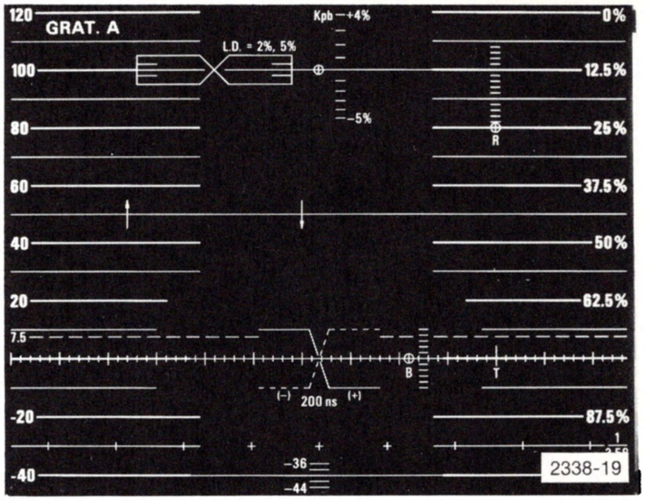


Fig. 2-5. NTSC Composite Graticule A supplied with 1480 and 1485.

Photo graticules are reduced in scale to eliminate parallax errors. The CCIR Composite/K-Factor graticule, the NTSC Composite Graticule A, and a special Short Time Distortion measurement graticule for NTSC (Graticule B) are all available in both visual and photo scales.

The special Short-Time Distortion graticule for NTSC (Graticule B) are all available in both visual and photo scales.

The special Short-Time Distortion graticule for NTSC, Graticule B, is supplied with 1480 and 1485 only. Graticule B is shown in Fig. 2-6. Graticule B's two masks, 2% and 5%, are in accordance with IEEE Trial Standard 511-1974. Information on the use of all three major measurement graticules can be found in Tektronix Television Products Application Notes 12 and 20, contained in Section 3 of this manual.

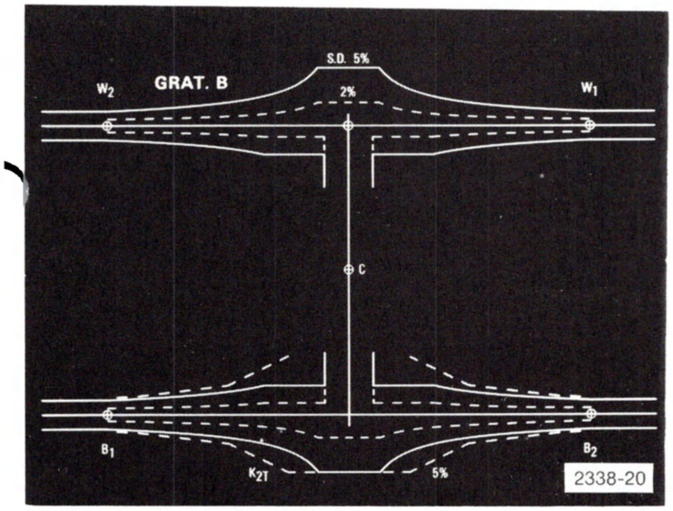


Fig. 2-6. NTSC Short-Time Distortion measuring graticule, Graticule B.

An NTSC non-composite pattern is available as an optional, extra-cost, external graticule. Refer to the TV Products Catalog or call your local Tektronix representative.

Graticule horizontal scales are divided into 12.7 divisions along the horizontal line at blanking level. The vertical graduations are scaled according to measuring units and ranges peculiar to each system—mV for the CCIR graticule, and IRE units and percent modulation for NTSC. The graticules are also marked for K-factor tolerances and linear-distortion measurements.

Internal

With the SCALE ILLUM control pushed in, the internal graticule is edge-lighted. The range of illumination is sufficient for comfortable viewing in a studio environment or for taking waveform pictures with Tektronix Oscilloscope Camera Systems. The internal graticule offers parallax-free viewing that greatly enhances measurement of distortions, amplitudes, and level-setting adjustments.

External

External graticules can be installed quickly and easily. Simply unscrew the crt bezel cap nuts, remove the crt bezel and fit the graticule over the faceplate with the printed side in. Depending on the TV system for which the graticule is designed, the Back Porch Cal Ampl switch (see Fig. 2-7) must be positioned to the left (NTSC) or right (PAL) position to match the locating hole at the lower edge of the external graticule. Thus, when the PULL FOR EXT SCALE ILLUM control is activated to turn on the external-graticule lights, the calibrator signal amplitude will be automatically selected when the DC RESTORER is in BACK PORCH. SYNC TIP position always produces a 1-volt signal.

CAUTION

Failure to place the switch in the proper position will cause its destruction and an erratic or nonexistent calibration signal.

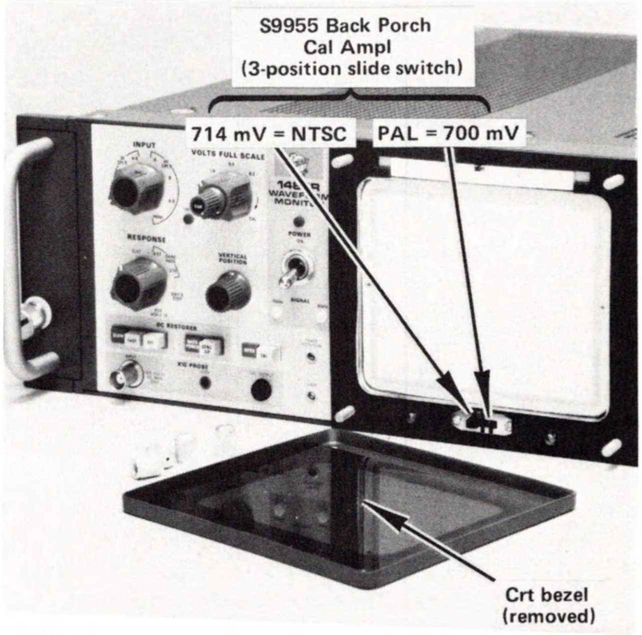


Fig. 2-7. Location of the Back Porch Cal Ampl switch, S9955. Same location for both rackmount and cabinet model.

OPERATING PRECAUTIONS

When operating the 1480-Series Waveform Monitors, front-panel controls can be set in a manner that exhibits anomalous displays. The following discussion identifies those operating modes that should be avoided.

1. In the ALL FIELDS mode center two buttons pressed), with DISPLAY in 5 μs/DIV or 10 μs/DIV, and the LINE SELECTOR VAR pressed, no display will be obtained if the LINE SELECTOR VAR potentiometer is set to display lines during the time a second field would have been displayed.

The ALL FIELDS mode time-overlays each successive field on the first half of the 2 FIELD display, thus the maximum ramp amplitude at the 2 Field Sweep Generator is 5 volts. The LINE SELECTOR VAR control has a range of 0 to 10 volts at the input to the 2 Field Sweep Generator. Since the LINE SELECTOR VAR control voltage is applied to one side of a comparator in the 2 Field Sweep Generator device, there is no delayed gate output if the LINE SELECTOR VAR is set above the maximum ramp voltage (5 volts).

2. The four front-panel FIELD buttons would seem to imply that the 1480-Series monitors identify four fields of any television system. In PAL systems, the Bruch sequence certainly identifies four fields, but NTSC and PAL without Bruch sequence systems have four less-clearly identified fields. These fields are determined by subcarrier phase with respect to the leading edge of line sync. The 1480-Series monitors positively identify four PAL fields in the presence of the Bruch sequence, but cannot identify fields that are different from each other only in the phase of the subcarrier with respect to line sync.

3. If composite PAL video is applied to the AUX VIDEO IN connector and composite sync to the EXT SYNC IN connectors, with no signal to the VIDEO INPUTS or with the INPUT switch in the PROBE position and SYNC in EXT, the 1480-Series monitors will not positively identify the four PAL fields even in the presence of the Bruch sequence. All the sync functions appear normal, but the Frame Pulse Generator does not receive burst information.

4. Do not attempt to use the AUX VIDEO IN as an end-of-line termination for a signal looped through other instruments if the 1480-Series POWER switch is off. With POWER on, the AUX VIDEO IN circuit is internally terminated in 75 Ω, but with POWER off, the impedance is around 80 Ω.

5. The additive calibrator mode (where the front-panel CAL and OPER buttons are pressed simultaneously) operates only with the video signal connected to the A VIDEO INPUT. If the INPUT switch is in B or PROBE, the display in the additive calibrator mode will still be whatever is connected to the A VIDEO INPUT superimposed on the calibrator signal.

6. With the INPUT switch in the PROBE position and the front-panel CAL button pressed, the DC Restorer is disabled and no clamping is done. The DC Restorer operates with the OPER button pressed.

7. The calibrator timing flipflop is disabled if the LINE SELECTOR 15 LINES button is pressed and the DISPLAY switch is in 5 μs/DIV, 2 FIELD, or EXT.

8. In PAL instruments, the lack of Bruch sequence in the incoming video signal causes loss of sweep if FIELD 1 or FIELD 4 buttons are pressed individually (12 1/2 Hz sweep rate).

9. In Option 4 and Option 5 (VTR T.W. Sync Input) instruments the DISPLAY switch in 10 μs/DIV and 2 Field sweep enabled through J9034, using the MAG switch causes the display to shift about one field to the left.

10. To prevent damage to the crt, the unblanking for the External Horizontal dislay mode is disabled. An internal wiring change is required to activate the unblanking. See "Using External Horiz In" on page 2-13.

MEASUREMENT TECHNIQUES

Using WAVEFORM COMPARISON

The most obvious use of the WAVEFORM COMPARISON function is to check amplitude ratios such as pulse-to-bar measurement. This measurement mode can be used on any line or pair of lines that can be displayed, including lines selected in the LINE SELECTOR modes.

WAVEFORM COMPARISON is also useful in comparing amplitudes of the modulated packets on the linearity staircase signal. Differential gain can be checked with the modulated staircase applied and the waveform monitor in the BANDPASS RESPONSE position and 0.2 VOLTS FULL SCALE. By overlaying the last modulation packet on the first, any differences can be easily viewed and measured.

Adjacent lines can be overlaid and amplitudes compared, using the 10 μs/DIV DISPLAY position. Locate the break-point at the line sync pulse in the center of the display and adjust OVERLAY control as necessary to overlay the two lines.

Using the Calibrator

The calibrator signal can be set to one of three values, as determined by front-panel switches. With the CAL and SYNC TIP DC RESTORER buttons pressed, the squarewave amplitude is one volt. No other value is possible, or needed, since all television standards employ a one-volt into 75 Ω composite video signal. Adjustment of the front-panel GAIN control in this mode is simply a matter of adjusting until the calibrator display coincides with the appropriate internal graticule markings. Measuring the distance from blanking to peak white is not so straight forward, since different television standards employ different amplitudes. Dual-standard models of the 1480-Series use a precise resistor divider with taps for different values. Which tap is used in determined by the setting of the Back Porch Cal Ampl switch and the position of the SCALE ILLUM switch. The Back Porch Cal Ampl switch is located inside the crt bezel below the crt.

When external graticule lighting is desired, pull the SCALE ILLUM control out. This also enables the Back Porch Cal Ampl switch to control signal amplitude. The setting of the Back Porch Cal Ampl switch is determined by a hole in the external graticule into which the switch thumb slide fits. NTSC graticules set the slide switch to the 714 mV tap on the resistor divider. CCIR graticules set the slide switch to the 700 mV position. See Fig. 2-1 and CAUTION note under External (page 2-9).

The calibrator signal is particularly useful in the additive calibrator mode. In this mode, both OPER and CAL are pressed, superimposing the A VIDEO INPUT signal on the calibrator waveform. Signal amplitude errors are easily distinguished by noting differences between the bottom of the upper display and top of the lower display.

Using the DC RESTORER

The DC RESTORER clamps either the back porch or the sync tip of the composite-video waveform to 0 V. The two rates of restoration (FAST and SLOW) allow the user to compare the signal in the presence of hum to the signal with hum attenuated. The FAST mode attenuates mains hum by at least 26 dB, while the SLOW mode attenuates by 0.9 dB or less.

In addition, an internal jumper can be changed to increase the fast clamp (restorer) speed. This jumper (P1993) should only be changed by a qualified technician because this change requires the removal of the protective covers. Instructions for this and other program changes appear in Section 6 of the SERVICE part of this manual.

In the fast slew rate, rapid restoration is accomplished but the circuit is more susceptible to noise. In the slower of the fast slew rates (the one normally programmed at the factory) the dc restorer is less susceptible to noise but is takes longer to clamp.

Clamping at the back porch is automatically selected internally when RESPONSE is in LOW PASS. Rise and fall of sync pulses in LOW PASS are so low that there is no sync tip left to clamp.

The DC RESTORER is inhibited in DIFF'D STEPS because the recovery of the differentiated sync pulse is not complete by either sync tip of back porch time.

The BANDPASS filters do not pass any dc or low-frequency signal components, so while the DC RESTORER still operates, it does not affect the display.

Using the AUX VIDEO IN and AUX VIDEO OUT

The AUX VIDEO OUT jack on the rear panel provides an unfiltered output, internally-terminated in 75 Ω. The AUX VIDEO IN is a 75Ω internally-terminated input that provides input access to the vertical system following the filters.

These two access points can form an external loop around the filters, and measurements or corrections can be made in this loop, for example, (using a chrominance-to-luminance delay corrector) without disturbing the input signal. An advantage of this function is the ability to compare a uncorrected signal with the corrected signal by switching between the AUX VIDEO IN and FLAT position of the RESPONSE switch.

The AUX VIDEO OUT is also one end of an impedance-converting network. The other end is the X10 PROBE input, available as an option. The signal acquired with the probe is processed in the same circuits as a video input. The AUX VIDEO OUT is internally terminated in 75 Ω, making it compatible with the rest of the video system. The signal acquired with the probe can then be routed through AUX VIDEO OUT to a display of measurement device such as a vectorscope.

Using a X1 probe for signal acquisition permits ten-times signal gain and is useful for low signals such as hum or residual subcarrier.

Using the RGB/YRGB Input (J9034)

J9034 provides control and signal access for stepping the Waveform Monitor Sweep with the RGB or YRGB staircase. The encoded line-rate or field-rate camera pick-up tube "parade" signal can then be applied to one of the VIDEO INPUTS and the various pick-up tube matching adjustments can be easily made.

J9034 pin D is the access for sweep length alteration. Grounding this point shortens the sweep, allowing the RGB/YRGB stair case to step the "parade" across the crt so that the outputs of the camera pick-up tubes are seen on the same display.

The RGB/YRGB staircase is applied to J9034 pin C. The staircase repositions the shortened sweep. (The sweep is not shortened in time, only in distance traveled across the crt.)

A mating, male plug (P9034) is available for applying external RGB/YRGB input signals to J9034. See Accessories in the rear of this manual for ordering information.

It is possible to alter the length of the sweep by changing the value of two resistors. Since this is a circuit change, it should be attempted only by a qualified technician. Information on these values changes can be found in Section 6 of the SERVICE part of this manual.

1480-Series instruments are shipped with plug-jumpers P4032 and P4240 installed. With these plugs in place, the gain is set for RGB operation; for YRGB operation they need to be removed. Because these changes require removing protective covers, they should only be done by a quailified technician, using the instructions from Section 6 of this manual.

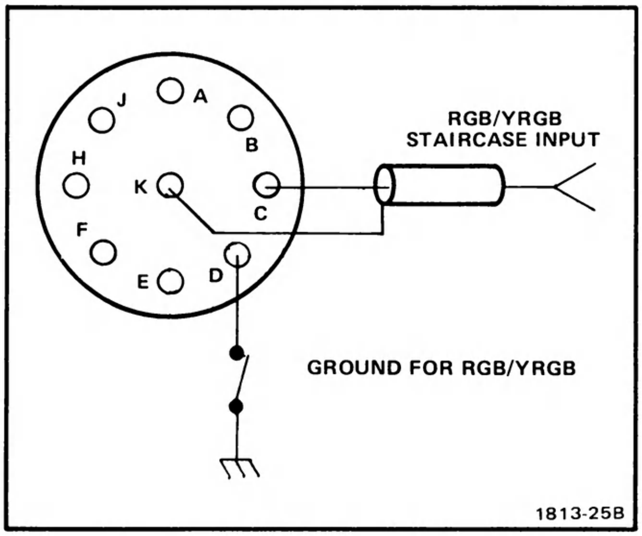


Fig. 2-8. J9034 connections for RGB or YRGB operation.

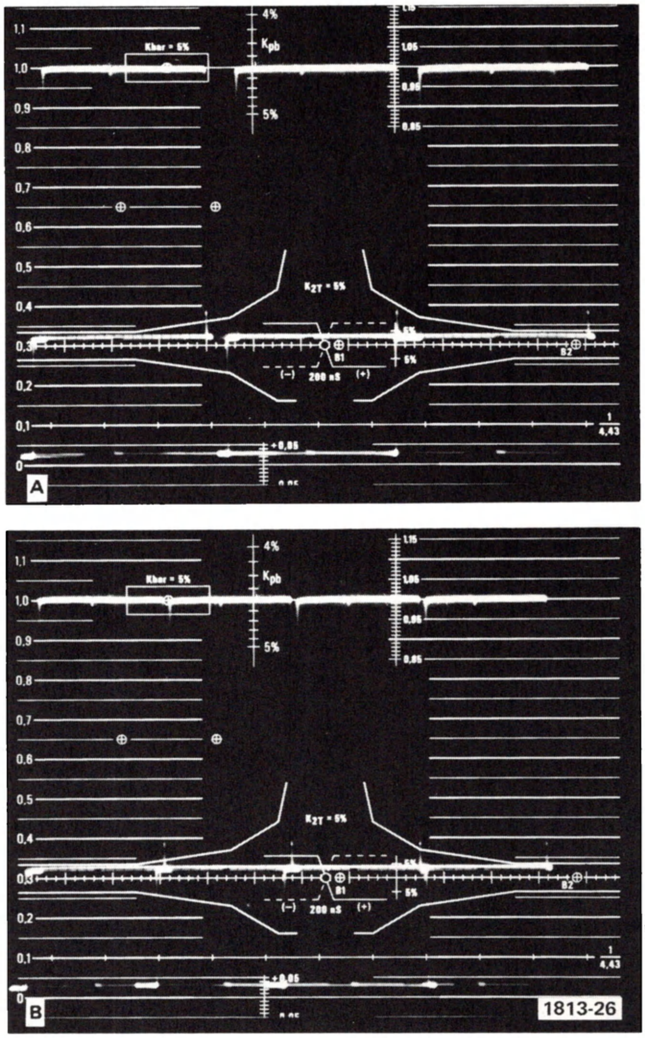


Fig. 2-9. (A) three step RGB display. (B) YRGB display, note 4 steps.

Using PIX MONITOR OUT

The amplifier that drives AUX VIDEO OUT also drives PIX MONITOR OUT. The only difference between the two outputs is that PIX MONITOR OUT contains the line strobe when the waveform monitor is in one of the LINE SELECTOR modes.

This output, when connected to a picture monitor, enables the user to view the waveform monitor display as a television picture and at the same time to see the exact location of the line or lines (15 LINE) selected by the LINE SELECTOR controls.

Some picture monitors do not react favorably when the inserted line strobe crosses the field sync area. External synchronization of the picture monitor should eliminate the unfavorable reaction.

Using LINE STROBE OUT

The LINE STROBE OUT is an ac-coupled, positive-going, TTL-compatible output, time-coincident with the line or lines selected by the LINE SELECTOR controls. This signal can be used to brighten a picture monitor display, or can be superimposed on an oscilloscope display for identification of selected lines. The LINE STROBE OUT can also be used as a form of delayed gate to trigger some other unit at the selected line.

Using DIRECT and AFC SYNC

DIRECT SYNC uses a wide-band trigger circuit that accepts and processes low-frequency signals as well as line-rate sync. AFC SYNC uses a narrow-band trigger circuit that is limited to 15.75 kHz ±200 Hz, but at the same time is relatively immune to noise.

Noise-caused jitter can be reduced by using the AFC mode, enabling the user to view a more stable waveform display.

Using EXT SYNC

The EXT SYNC function is useful when viewing a non-composite video signal, such as might be acquired through the optional X10 PROBE input. The sync signal used must lock both the waveform monitor and the unit under test.

A stable display can be obtained in the presence of small-amplitude signals, assuming the availability of at least 200 mV of composite sync to lock both the waveform monitor and the signal source.

Using EXTERNAL HORIZ IN

The EXTERNAL HORIZ IN is provided for signal input access in case some special sweep rate is required. A five-volt ramp will generate a 12.7 division trace. Input impedance of this circuit is about 10 kΩ.

Unblanking for External Horizontal operating mode is shipped from the factory in a disabled condition. An internal wiring change is required to activate this unblanking. See note on diagram 9.

OPTIONS

The following portion of the Operating Instructions deals with customer-ordered options. If none of the options listed here are in the 1480-Series Waveform Monitor used with this manual, disregard this part of the Operating Instructions.

OPTION 01 (X10 Probe)

Operating Instructions

The signal from the X10 PROBE INPUT is inserted in the vertical system at the same point as signals applied to the A and B VIDEO INPUTS. All front-panel controls then have the same effect on the X10 Probe signal as they have on other signals.

Pressing the front-panel CAL button provides a squarewave output at the CAL OUTPUT jack, to be used for probe compensation.

Connect a 10X Probe from the X10 PROBE INPUT to a source of 1-volt peak-to-peak composite video. Set the VOLTS FULL SCALE to 1.0, RESPONSE to FLAT, INPUT to PROBE, DISPLAY to 10 μs/DIV, and MAG to OFF. Press the DC RESTORER SLOW and BACK PORCH, OPER, EVEN FIELD, SYNC INT and AFC, LINE SELECTOR off buttons. This will cause a 1-volt display.

Set the front-panel controls to each position in turn and note that the effect is the same for the X10 PROBE signal as for normal operation.

OPTION 02 (Carrying Case For Cabinet Models)

This option has no effect on the operation of the 1480-Series Waveform Monitor.

OPTION 03 (Blank CRT)

This option is ordered for use with special graticules. Operating instructions, out of necessity, will be generated by the user.

OPTION 04 and OPTION 05 (VTR Tone Wheel Sync)

Operating Instructions

Option 04 is available in single-standard and dual (NTSC-PAL)-standard cabinet models (1480C, 1481C, 1482C, and 1485C). It's designed to trigger on the tone wheel sync output of VTRs. The CRT and line voltage settings depend on the instrument model ordered. The Option 05 is functionally identical to the Option 04 except that it has an NTSC internal graticule scale, is specifically wired for 120 V primary mains, and is available on the NTSC-PAL dual standard model (1485C) only.

With the 1480-Series Option 04 or 05 Waveform Monitor installed in an RCA TR70C, operation is virtually automatic. The TR70C provides external locking signals so that the Waveform Monitor displays the signal of interest.

The signal of interest is selected by pressing one of the Waveform Monitor Selector pushbuttons, located on the TR70C panel below the Waveform Monitor. For detailed instructions about using the Waveform Monitor in the TR70C, see RCA Operation and Installation Manual, 1B-32168. Some typical displays are shown in Figs. 2-10, 2-11, and 2-12.

OPTION 06 (124 Ω Balanced Inputs)

Option 06 is a large-scale modification of the 1480-Series Waveform Monitor and for that reason employs its own Instruction Manual Supplement (Tektronix Part Number 070-2064-00) which contains complete operating instructions.

OPTION 07 (Slow Sweep)

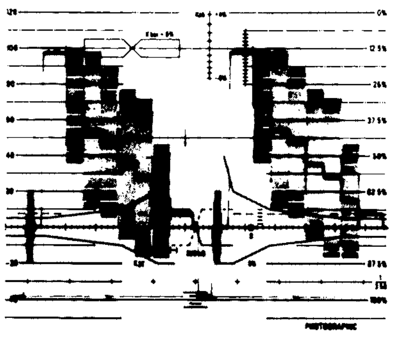
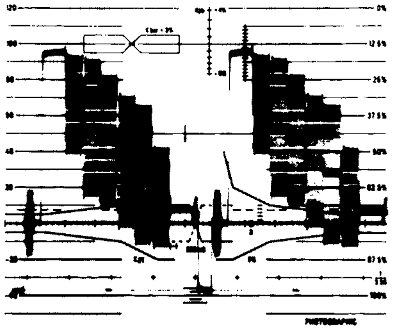
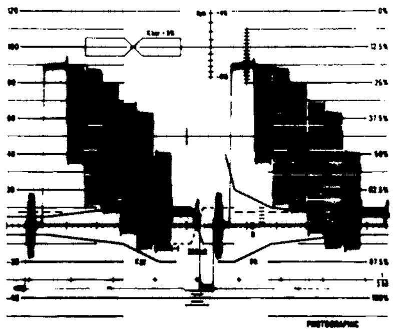
Slow Sweep uses triggering either from internal or external source. Display mode is selected by the setting of the DISPLAY switch. It can be set to +TRIG PLRT (triggering polarity), which starts the triggered sweep on the transition from black or near black to white or near white, or −TRIG PLRT which is the opposite transition.

Sweep duration is controlled by a variable, labeled VAR, which provides a change in sweep speed of about 3 to 1.

50/60 Hertz Triggering uses the rear-panel AUX SYNC INPUT connectors. Triggering mode is selected by simultaneously depressing both INT and EXT SYNC pushbuttons.

OPTION 08 (SECAM Field Identification)

Option 08 is a large-scale modification available only on the 1481 and 1485 Waveform Monitors. For that reason it employs its own Instruction Manual Supplement (Tektronix Part Number 061-1716-00) which contains complete operating instructions.

TR-70C PUSHBUTTON	1480-Series DISPLAY
IN 1813-61	 **Displays VIDEO INPUT A signal as a reference to allow for correct level adjustments.**
DEMOD 1813-62	 **Displays the video output from the demodulator.**
ATC 1813-63	 **Displays the video from the Automatic Time Corrector.**

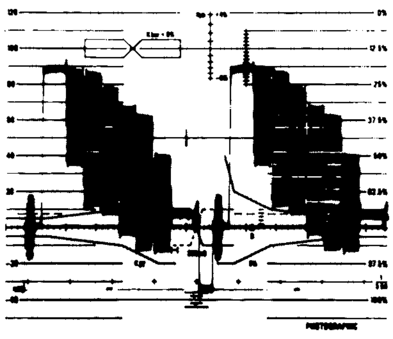
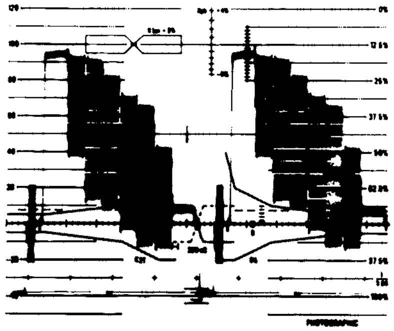
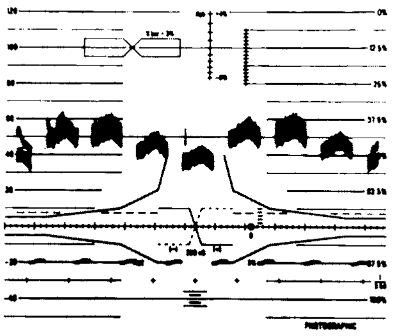
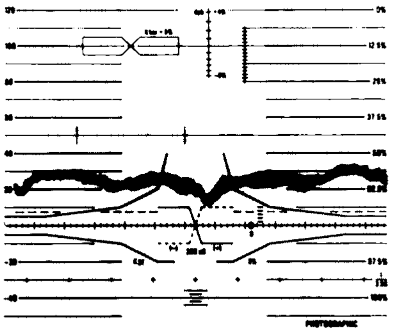
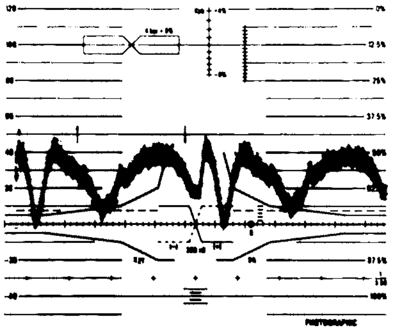
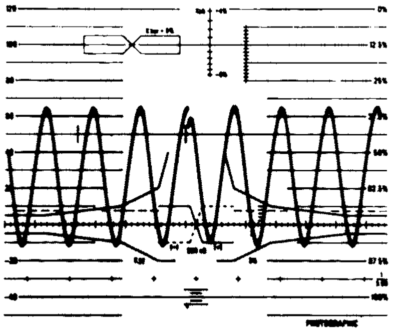
TR-70C PUSHBUTTON	1480-Series DISPLAY
CATC 1813-64	 **Displays the video from the Color Automatic Time Corrector.**
OUT 1813-65	 **Displays the TR 70C output video to allow for level checking.**
FM LEVEL 1813-66	 **Head-by-head display of detected FM from the playback head amplifier.**

Fig. 2-10. Operating waveforms from RCA Video Tape Recorder model TR70C.

TR-70C PUSHBUTTON	1480-Series DISPLAY
ATC 1813-67	 Displays error signal from the Automatic Time Corrector module.
CATC 1813-68	 Displays error signal from the Color Automatic Time Corrector module.
CT REC 1813-69	 Displays the record current signal in the control track head in the record mode.

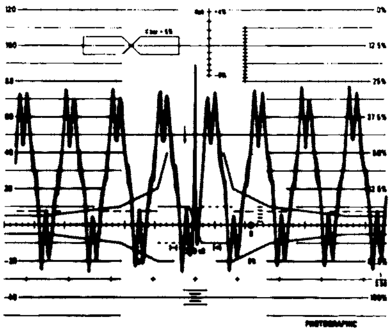
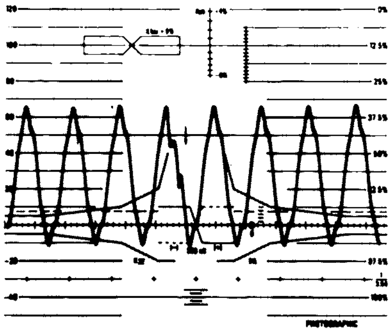
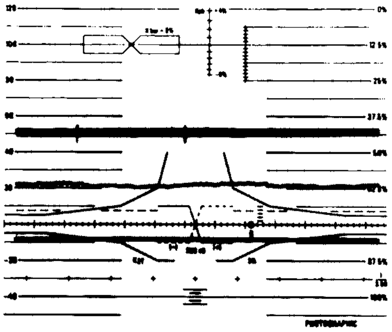
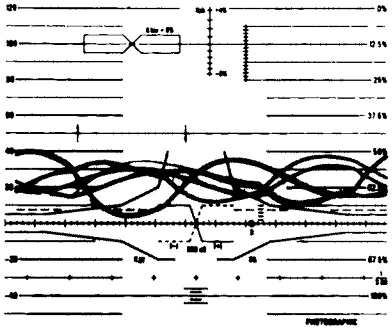
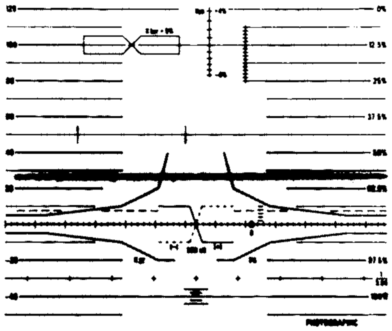
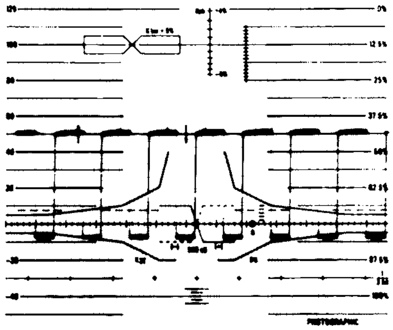
TR-70C PUSHBUTTON	1480-Series DISPLAY
CT PB 1813-70	 Displays capstan servo control track signal in the playback mode.
CT PB (Record Mode) 1813-71	 Displays control track during record for check of proper control track signal.
CAC 1813-72	 Displays line-by-line chrominance error signal.

Fig. 2-11. TR70C operating waveforms (cont).

TR-70C PUSHBUTTON	1480-Series DISPLAY
GUIDE 1813-73	 Displays a signal from the guide servo system as a performance check for that system.
REF 1813-74	 Displays the reference pulse as an operational check of the reference generator.
HW 1813-75	 Displays a signal from the head wheel servo system that indicates lockup of the system either in record or playback mode.

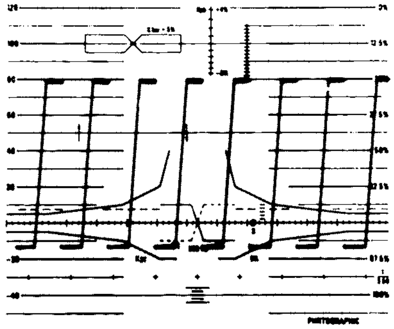
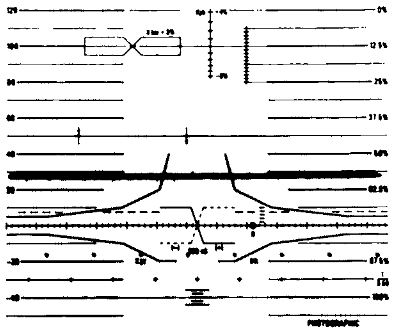
TR-70C PUSHBUTTON	1480-Series DISPLAY
CAP 1813-76	 Displays a signal from the capstan servo system that indicates lockup of the system either in record or playback mode.
TW 1813-77	 Displays the tonewheel pulse as an operational check of the tonewheel processor.

Fig. 2-12. TR70C operating waveforms (cont).

APPLICATION NOTES

Information contained in this section is of a specific nature and goes far beyond normal Operating Instructions. In some cases the information is new and has been added to this manual to keep it current. Whenever new information, concerning the operation of this instrument, becomes available in application note form, it will be distributed through mailings and later be bound into reprints. In order to keep this manual current, periodically check with a Tektronix Television Specialist or sales representative about any new Application Notes pertinent to this instrument.

Some of the Application Notes in this section were authored by renowned authorities in the field of video measurement. Their topics include some new and highly accurate measurement techniques that are destined to become standards of the television industry.

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Application Note	Title
11	Measurement of Signal Level with the 1480-Series of Waveform Monitors
12	Operational 625-Line Measurements with the 1480-Series of Waveform Monitors
13	Time Base Fold Back, A Novel Improvement Over Double Triggering for Video Testing
14	Superimposing Alternate Field ITS to Improve In-Service Testing
15	Enhanced Video Measurement Capability Using the 15-Line Display of the TEKTRONIX 1480-Series Waveform Monitors
16	Verifying the Bruch Blanking Sequence
17	The Auxiliary Video of the 1480-Series of Waveform Monitors
20	A New NTSC Graticule For the 1480 Waveform Monitor
21	All Fields Display to Improve NTSC In-Service Testing

application notes

TEKTRONIX®
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technical excellence

no. 11

The Measurement of Signal Level with the 1480-Series of Waveform Monitors

by L.E. Weaver
Tektronix European TV Engineering Consultant

The amplitude of the video signal needs to be set to its correct value within a very small tolerance range at all points in the TV signal chain where such waveforms are found.

This requirement has been fully taken into account in the design of the 1480-Series of Waveform Monitors, which provide the user not only with the conventional square wave calibrating signal, but also with level measuring facilities of a kind not previously found in commercial instruments.

The method employed is not, in fact, novel, since it was first described more than 10 years ago[1], and it has for a long time been in standard operational use by a TV broadcasting organisation internationally known for its high standards, but its merits as an operational procedure do not seem to have been more widely recognised until now.

How it Operates

The basic principle is remarkably simple, although it is very easy to make it appear quite complicated. For the sake of clarity, therefore, suppose it is required to set the overall amplitude of the video signal by means of an ITS signal, say the internationally-agreed line 17. By definition, this amplitude is the voltage difference between the mid-point of the top of the luminance bar and the mid-point of sync bottom.
Now set up the waveform monitor as follows:

INPUT	A (looped-through or correctly terminated at input)
VOLTS FULL SCALE	1.0, CAL
RESPONSE	FLAT
DC RESTORER	FAST, SYNC TIP, OPER and CAL buttons both depressed
MAG	OFF
DISPLAY	5 μs/div
FIELD	1, 3
LINE SELECTOR	17, DIG
SYNC	INT, DIRECT
ALL FIELDS	OFF

The display obtained with these settings will probably seem confusing just at first glance, so to make it clearer to understand reduce the input temporarily to about 50% of the previous value, when it will be evident that the display consists of the same ITS waveform, repeated at two levels (Figure 1).

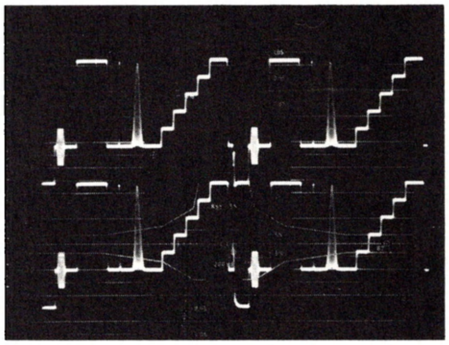


Figure 1. *Normal display at reduced amplitude*

What, in fact, has happened is that a square wave whose period is 4H, i.e. 4 times line duration, and whose amplitude is exactly one volt, has been linearly added to the test waveform. A complete cycle of the square wave looks like the photograph (Figure 2) with a pair of TV lines successively located at each of the two voltage levels, but the synchronizing arrangements of the 1480-Series are such that the display always appears in the overlaid form.

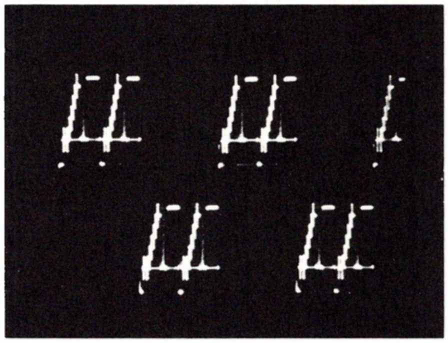


Figure 2. *Display locked to calibrating square wave.*

Since the vertical separation of the two traces is as has been said, exactly one volt, it follows that when the sync bottom of the upper trace is located on precisely the same horizontal graticule line as the bar top of the lower trace, then the overall amplitude of the video signal is also one volt. This provides a very simple criterion for determining when the correct level has been achieved, which is free from parallax error and at the same time independent of changes in average picture level because of the operation of the D.C. restorer.

Setting the Overall Level

The basic practical procedure is therefore as follows. Check that the correct waveform is being displayed; this should appear at two levels, as has been explained above. Select a convenient horizontal graticule line as a reference, and position the display so that the sync bottom of the upper waveform and the bar top of the lower waveform are roughly equidistant about this line. Then as the level is varied it will be found very simple to bring the sync bottom and the bar top into the same horizontal line, using the reference line as a guide. This is the correct setting for the video level.

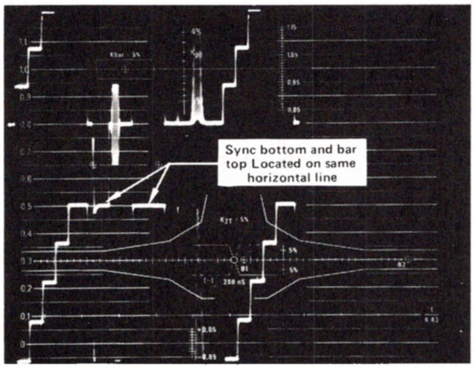


Figure 3a. *Correct setting with gain normal.*

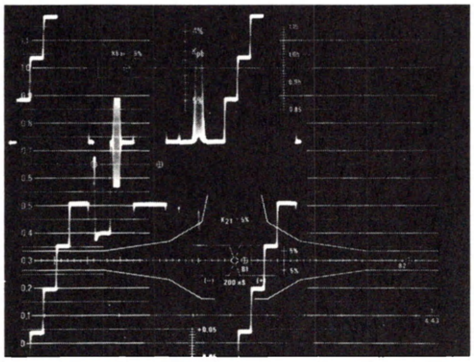


Figure 3b. *Level 10% high.*

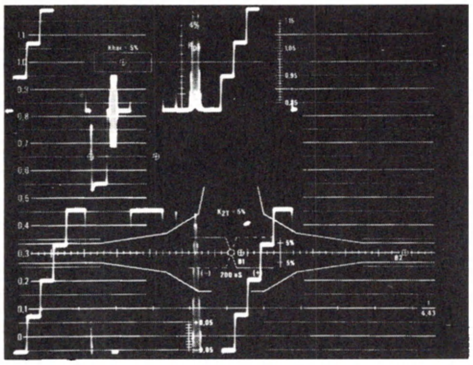


Figure 3c. *Level 10% low.*

Improving the Resolution

When the signal amplitude is increased from, say 1.0 to 1.1 V, the separation between the bar top and the bottom of sync also increases by the same amount, which appears as one full graticule division on the display. Hence a voltage ratio of 1.1:1, i.e. 0.8dB, is equivalent to a division. If it can be assumed that the signal is not unduly noisy, which will certainly be the case in studio areas, one can estimate the resolution of the measurement to be about one tenth of a division, say 0.1 dB.

This is good enough for some purposes. However, with the 1480-series the gain may be increased by up to five times without distortion, so that the resolution can be improved to a figure of about 0.02 dB, which offers the possibility of very accurate measurements (Figure 4).

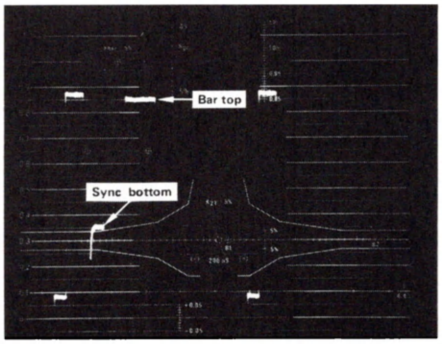


Figure 4. *Level 10% high, X 5 gain.*

The resolution obtained in practice is, of course, limited by the random noise level present in the signal under test. That is in no way special to the present method, but is perfectly general. Where the signal is noisy, a useful improvement is possible by first passing it through a low pass filter, which reduces the bandwidth without unduly deforming the flat portions of the bar and the sync pulse, although the accuracy will then depend upon a correct allowance being made for the insertion loss of the filter. The amount of improvement obtained is a function of the character of the random noise.

With the 1480-Series a useful device is to alter the RESPONSE control from FLAT to IRE, which attenuates the higher video frequencies with very little distortion but does not affect the calibration of the instrument. In more severe cases, the use of the LOW PASS setting is permissible. The marked improvement which can be obtained in this simple way is very clearly shown in Figures 5a, 5b, and 5c.

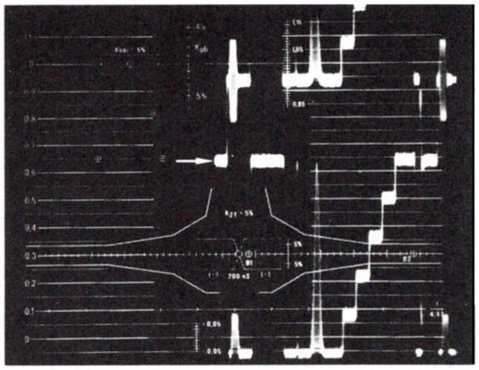


Figure 5a. *Signal with random noise, FLAT response*

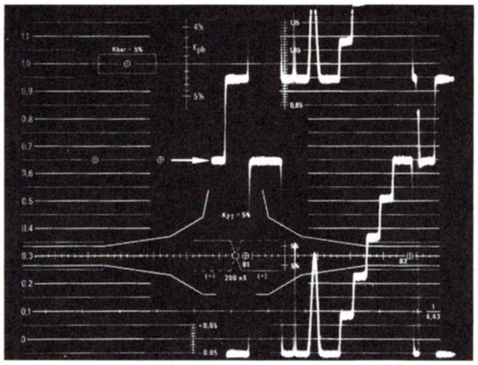


Figure 5b. *As Figure 5a but IRE response.*

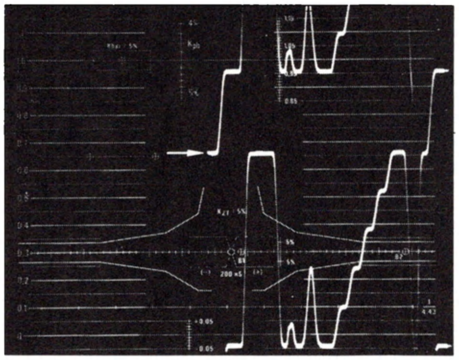
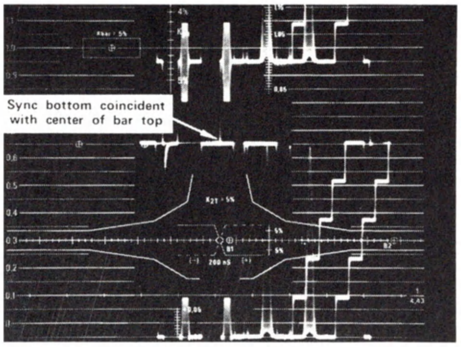


Figure 5c. *As Figure 5a but LOWPASS response.*

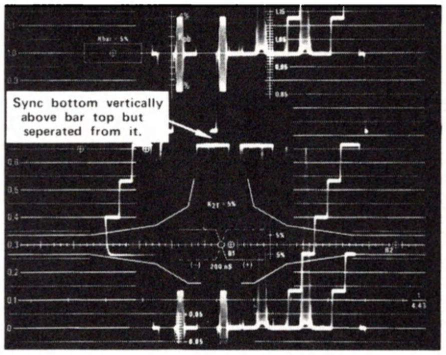
Use of Overlay

Yet a further improvement can be effected by the use of the overlay facility of the 1480-Series, which makes it possible to bring the bar top and the sync pulse bottom into the same vertical axis, with the result that the correct adjustment of level is achieved with the two reference points actually overlaid. Apart from the added convenience of use, this provides a small but significant improvement in resolution, since it is easier to adjust for minimum thickness of line than it is to ensure that the two reference points lie on the same horizontal graticule line. The appearance of the display with both a correct and an incorrect adjustment is shown in Figures 6a and 6b.



Sync bottom coincident with center of bar top

Figure 6a. *Use of OVERLAY, level correct.*



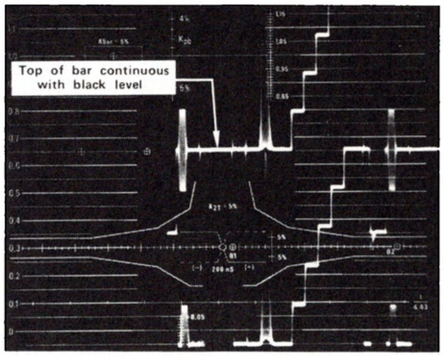
Sync bottom vertically above bar top but seperated from it.

Figure 6b. *As Figure 6a but level 5% low.*

Measurement of Picture Component

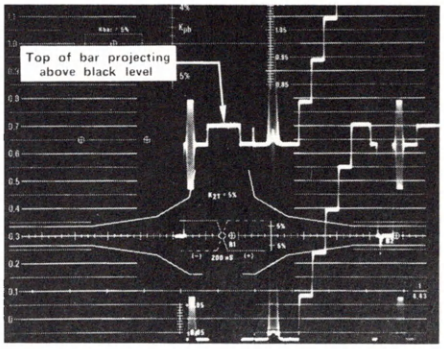
So far, the setting of video level has been described entirely in terms of the overall one volt amplitude of the signal. However, it is often required to check the amplitude of the picture component in addition. This is quite simply brought about by changing the DC RESTORER button from SYNC TIP to BACK PORCH. This not only alters the clamping mode, but at the same time brings in a square wave whose amplitude is 700 mV for 625-line signals or 714 mV for 525-line signals. With dual-standard instruments the changeover is effected automatically when either the internal or the external graticule is brought into use by actuating the SCALE ILLUM control.

The procedure is exactly the same in principle as that used for the overall amplitude, and the same remarks apply, with the exception that the use of the overlay facility is less advantageous, as can be seen from the photographs Figures 7a, 7b.



Top of bar continuous with black level

Figure 7a. *Measurement of picture component, level correct.*



Top of bar projecting above black level

Figure 7b. *As Figure 7a but level 10% high.*

The sync pulse amplitude is not measurable directly by this method, but of course it is available by subtracting the picture amplitude from the overall.

Comments

This method of setting and measuring the level of video signals has the great advantages of absence both of parallax and of the transfer error associated with the conventional method.

To understand what this latter means, consider how such a measurement is most usually carried out. A calibrating square wave is first displayed, and the vertical gain is adjusted until it appears to fit as well as possible between two fixed graticule lines. The square wave is then removed, and the video waveform displayed and compared against the same pair of reference lines.

Several sources of error enter into this process. There will be some uncertainty in fitting the calibrating waveform against the reference lines, and a similar uncertainty when the video waveform is compared with them. In addition, the vertical gain will change by some finite amount between these two settings particularly when, as often happens in practice, they may be separated by relatively long periods of time. The sum of these is the transfer error which, of course, is very appreciably magnified when parallax is present.

None of these errors occurs in the method described above, whose accuracy is impaired only by the tolerance range in the square wave amplitude itself, and the inaccuracy of setting. To take an example, the square wave amplitude in the 1480-Series is defined within ±0.2%, and it has been shown above that the comparison error is probably not more than about 0.2% under suitable conditions. The overall error is therefore likely to be only about ±0.4%. When one takes into consideration the fact that the convention al method does not permit the use of amplification to reduce the setting inaccuracy, it is clear that the present method shows a very considerable advantage, which is increased still further when an external graticule is in use and parallax errors are present in addition. The principal drawback of the method is its dependence upon a reasonably distortion-free signal. While good signals can be relied upon in picture generation areas, it is possible to find long-term distortions on distribution networks, for example, which can seriously affect the accuracy. In these instances, a modification of the transfer method is to be preferred. A suitable technique is described in Part 6 of the Tektronix Application Note 12, "Operational 625-Line Measurements with the 1480-Series of Waveform Monitors."

1: Weaver, L. E., The accurate measurement of video levels, EBU Review, Part A, vol. 69, pp. 2-4 (1961).

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X-3069

application notes

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no. 12

Operational 625-Line Measurements with the 1480-Series of Waveform Monitors

by L. E. Weaver
Tektronix European TV Engineering Consultant

The well-planned and in certain respects novel display facilities provided on the 1480-Series of waveform monitors have made it possible to produce a new 625-line graticule enabling a full range of video waveform measurements to be carried out with a minimum number of manipulations, consequently simplifying operational procedures. In view of the growing importance of in-service measurements, its design has been based upon the international insertion test signal on line 17, but it can also be used, for example, with the U.K. national insertion test signal on line 19.

A clear and uncluttered graticule which is extremely simple to use has been ensured by functional planning and by the omission of all superfluous information. For instance, the K-factor limits have been restricted as far as practicable to a single value of 5%, chosen because it may be regarded broadly as a dividing line between distortions which are subjectively acceptable and those which rapidly become increasingly intolerable. It is also just slightly greater than the limit specified for the overall distortion in a high-quality television chain including one main transmitter[1].

Nevertheless, this has not resulted in a loss of reading accuracy since the distortionless windowing facility of the 1480-Series means that the vertical gain control can be relied upon as a simple and convenient way of changing the basic tolerance value by a series of known factors, i.e. the one diagram serves for 5%, 2½%, and 1% limits at the turn of a knob. These should be sufficient for practical purposes.

As an illustration of the applications of this new graticule in conjunction with the 1480-Series of waveform monitors, a brief summary of a suggested measurement procedure is given below. It should be noted that, apart from the initial settings and the inevitable readjustments of positioning controls and gain, only a single control needs to be moved throughout the series of measurements.

Measurement Procedure

Part 1: K_{bar} and K_{pb}

Control Settings:	Line Selector	17 and DIG
	FIELD	1 and 3 together
	DC RESTORER	BACK PORCH FAST
	MAG	OFF
	DISPLAY	5 μs/div
	RESPONSE	FLAT
	VOLTS FULL SCALE	1.0

Set the start of the trace against the left-hand edge of the graticule, and by using the VOLTS FULL SCALE VAR control in conjunction with the horizontal and vertical positioning controls, set the waveform so that black level coincides with the 0.3 line, the centre of the bar top passes through the circle in the K_{bar} "box", and the bar transitions pass through the pair of circles below the "box".

The value of K_{bar} is then read as the largest of the deviations of the bar top from the central horizontal line, whether above or below, between the vertical lines forming the ends of the "box".

The value of K_{pb} can also be obtained from the position of the peak of the 2T pulse on the scale marked K_{pb}.

If K_{bar} is appreciably less than 5%, the reading accuracy can be improved by using the VOLTS FULL SCALE control as a multiplier, and resetting the vertical position so that the centre of the bar again passes through the circle. The two steps convert the "box" limits of 5% into 2½% and 1% respectively. The appearance of the display during this measurement is given by Figure 1. (This figure is satisfactory for use as a routine check, but it has been obtained from a 10 μs bar instead of the 25 μs bar specified for K-rating purposes. A common way out of this difficulty is to double the 10 μs bar value to give a K_{bar} comparable with the figure which would be obtained with a 25 μs bar.)

Note: If there is any serious tilt of black level on the video signal there is an ambiguity in the setting of black level against the 0.3 line. It can be shown that the minimum error is obtained when the trace coincides with this reference line at the point marked B_1 on the graticule[2].

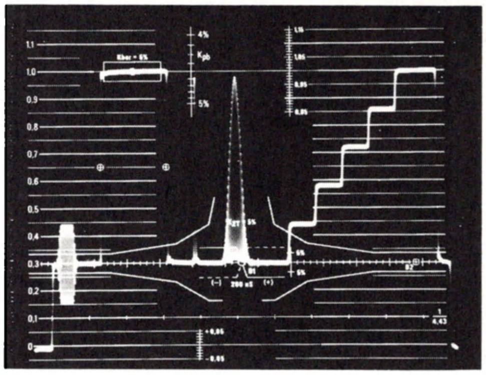


Figure 1. *Measurement of K_{bar} and K_{pb}.*

Part 2: K_{2T}

Control Settings:	MAG	x25 (200 ns/div)
	Others	As in Part 1

Turn the HORIZONTAL POSITION control until the 2T pulse is located symmetrically within the "submarine" tolerance diagram, with black level lying along the 0.3 line and the peak of the pulse coinciding with the 1.0V line as in Figure 2a; the variable gain control will usually be required to achieve this. The symmetrical positioning of the pulse is best checked against the pair of uppermost lines.

K_{2T} is read as the greatest deviation of the baseline of the 2T pulse from flatness, using the tolerance limit lines as reference, e.g. if the distorted baseline just reached the limit lines at one or more points, then the value of K_{2T} would be 5%. Other values can be obtained by interpolation, or for appreciably smaller readings by increasing the vertical gain as described in Part 1 above, giving the type of display shown in Figure 2b.

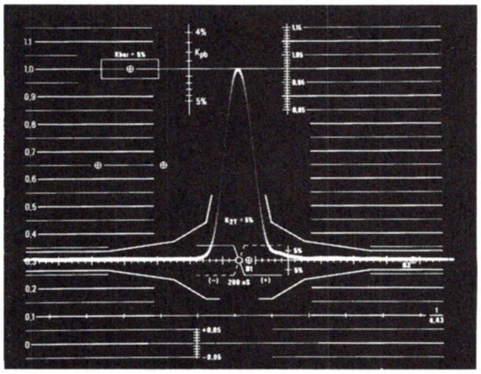


Figure 2a. *Measurement of K_{2T}.*

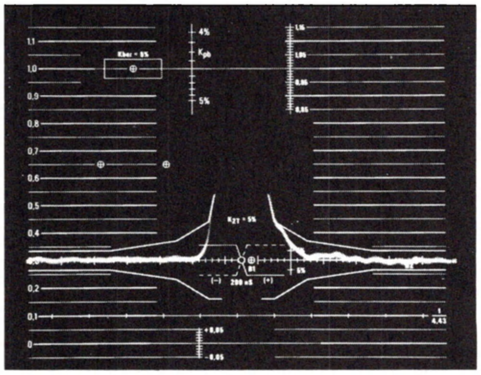


Figure 2b. *As Figure 2a, but VOLTS FULL SCALE set at 0.2.*

Part 3 (optional measurement): Bar Trail (Smear)

Control Settings: As immediately above.

In a linear system distortion at the lower video frequencies is measured by the value of K_{bar}, but in some instances a type of non-linearity distortion may be present which gives rise to a slow decay of the trailing edge of the bar not consistent with the distortion of the bar top. A measure of the seriousness of this may be obtained immediately after the K_{2T} reading by shifting the trace horizontally until the mid-point of the trailing edge of the bar coincides with the right-hand member of the pair of circles beneath the K_{bar} "box" (Figure 3). The percentage bar trail can then be found from the point where this transition intersects the small vertical scale located between points B_1 and B_2.

Another form of this distortion may cause an undershoot followed by a slow rise to the final value. This is read off in exactly the same manner.

Note that this measurement does not form part of the standard K-rating method, but it has been found useful in the Federal Republic of Germany, and is at present under consideration by the CCIR[3].

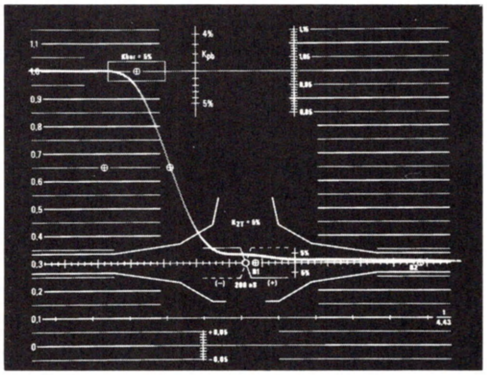


Figure 3. *Measurement of bar trail.*

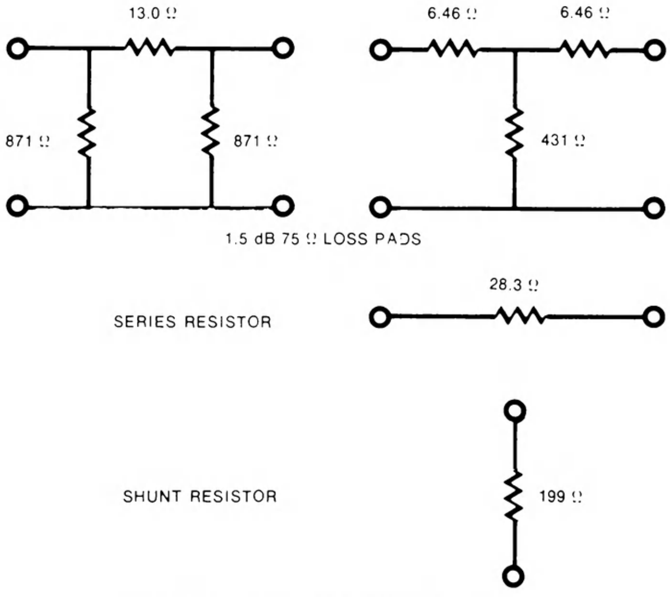
Part 4: Chrominance-Luminance Gain and Delay Inequalities

Control Settings:	MAG	x5 (1 μs/div)
	Others	As in Part 1.

There are two ways of carrying out this measurement. The first, by far the most convenient and accurate, utilizes a TEKTRONIX 1478 Calibrated Chrominance Level Corrector.

A. The 1478 may be inserted directly in series with the video signal under test. Alternatively, an arrangement which is much to be preferred when in-service measurements are to be carried out, the 1478 is connected in the AUX VIDEO path. It is then available simply by turning the RESPONSE control to AUX VIDEO IN, without the need for breaking the signal feed. However, since this path has a gain of 1.5 dB to allow for the loss of passive networks which may be used there, it will be necessary to introduce a compensating loss in front of the 1478. Preferably, this should take the form of a 75 Ω, 1.5 dB loss pad, but since all impedances are resistive, even a shunt or series resistor will suffice if facilities are limited. Values are given in the diagram.

The measurement then proceeds as follows.



1.5 dB LOSS CIRCUITS FOR AUX VIDEO PATH

Set black level along the 0.3 reference line and check that the midpoint of the bar top passes through the circle in the K_{bar} "box". Then rotate the HORIZONTAL POSITION control until the baseline of the 20T chrominance pulse is located symmetrically within the "submarine" diagram (Figure 4a).

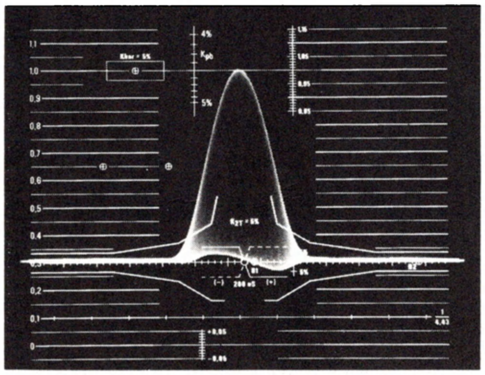


Figure 4a. *Measurement of 20T pulse baseline.*

Adjust the 1478 Corrector until the amplitudes of the upper and lower lobes formed by the pulse baseline intersecting with the 0.3 reference line are equal. The chrominance-luminance gain inequality is then derived from the Corrector reading (consult instrument manual).

Without disturbing this setting, check that the crossover point of the baseline coincides with the circle forming the centre of the limit diagram, and if necessary adjust the horizontal position to achieve this.

The peak-to-peak amplitude of the pair of lobes is then a measure of the chrominance luminance delay distortion. The pair of horizontal lines correspond to 200 ns, which may be considered as a limiting value for a high-quality TV system. This can be converted to 100 ns and 40 ns respectively by the use of the gain steps of the VOLTS FULL SCALE control. This diagram may also be used with a 10T chrominance pulse provided the indicated readings are halved. The limiting value for systems employing the 10T pulse is accordingly 100 ns.

Baseline lobes corresponding to the full-line portion of the diagram show a chrominance lag, termed positive by convention. The broken lines denote a chrominance lead, that is a negative error.

B. When no 1478 Calibrated Chrominance Corrector is available it is still possible to make a measurement of the chrominance-luminance gain and delay inequalities, but with greatly reduced accuracy.

This method depends upon the fact that these quantities are calculable if the amplitudes of the two lobes into which the pulse baseline is deformed as a result of the distortion, are individually known. Consequently, one sets the black level of the signal under test along the 0.3 graticule line, and adjusts the gain until the peak of the 20T pulse just touches the 1.0 line; this normalizes the pulse amplitude. The display is then shifted vertically so that black level now lies along the 1.0 graticule line, when by shifting the trace horizontally the amplitudes of the two lobes can be read from the upper graduated scale (Figure 4b).

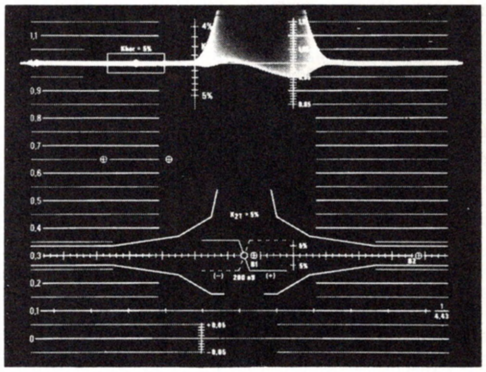
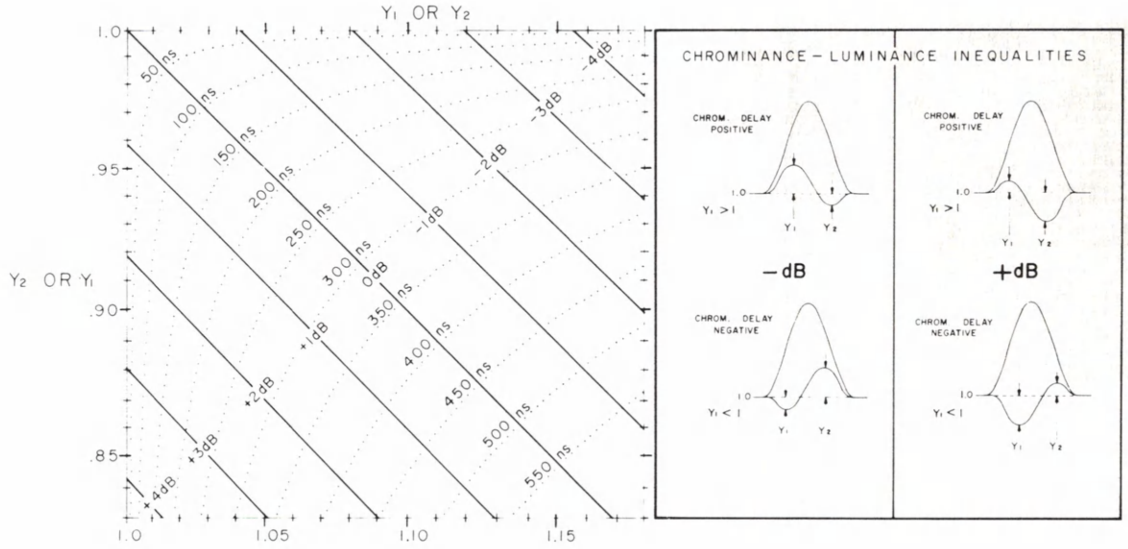


Figure 4b. *Measurement of baseline lobes for use with the nomogram.*

This pair of values, denoted Y_1 and Y_2 respectively, is transferred to the attached nomogram, from which the chrominance gain and delay inequalities are read. The table of diagrams inset should make the polarities of the distortions clear. Note that the nomogram is calibrated in terms of the actual figures read from the scale, so that zero lobe amplitude would be taken as 1.0.



As in the other measurements in this series, improved resolution is furnished by the use of the increased gain positions of the VOLTS FULL SCALE control. It is also helpful, if the means happen to be available for this purpose, to unlock the subcarrier frequency, which results in a considerably better defined chrominance envelope.

Although the graticule has been designed primarily for use with the 20T pulse, it may also be employed with a 10T pulse provided the readings of delay error are halved. The gain error readings are identical.

Part 5: Luminance Non-Linearity

Control Settings:	MAG	OFF
	Others	As in Part 1.

Check that the test signal amplitude is correct, and adjust if necessary as given in Part 1.

Rotate the HORIZONTAL POSITION control until the staircase waveform appears in the centre of the display. Set the RESPONSE control to the DIFF'D STEP position, when a group of 5 sine-squared pulses will appear as a result of the differentiation of the staircase transitions.

Adjust black level to coincide with the 0.3 line, and shift the trace horizontally so that each pulse in turn is placed against the right-hand linear scale. Measure the amplitudes of the largest and the smallest as accurately as possible; let these be A_{max} and A_{min} respectively. Then the percentage non-linearity distortion is given by $\frac{A_{max} - A_{min}}{A_{max}}$ X100, which may more conveniently be calculated if the amplitude of the largest pulse, A_{max} is made 7 graticule divisions (0.7V). The expression then simplifies to$(1 - 1.4\,A_{min})$X100.

In very many instances it is possible to utilize the VOLTS FULL SCALE VAR control to set the largest pulse to 10 graticule divisions by making it extend from the 0 line to the 1.0 line, when the distortion is given even more simply by $1 - A_{min}$ X100, and the calculation required is minimal.

Another way of comparing the amplitudes of the differentiated pulses which is sometimes useful is to make use of the OVERLAY facility, by means of which any pair of pulses can be overlaid, and their amplitude difference made clearly visible. Both the increase of amplitude to 10 divisions and the use of the overlay facility are illustrated in Figure 5.

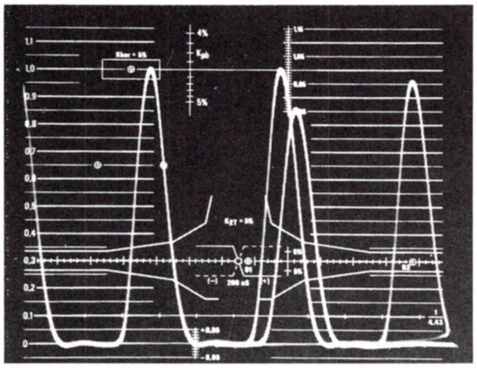


Figure 5. *Measurement of differentiated pulse amplitudes using OVERLAY.*

Part 6: Video Level Measurement

Control Settings:	MAG	OFF
	Others	As under Part 1.
	Note: the VAR VOLTS FULL SCALE control must be in the CAL position.	

A rapid estimate of the amplitude of the video signal can be obtained under operational conditions by the following procedure.

Rotate the HORIZONTAL POSITION knob until the mid-point of the bar top coincides with the right-hand vertical scale line. Adjust the VERTICAL POSITION control until the signal black level is in coincidence with point B_2 (Figure 6). The amplitude of the picture component can then be read against the graduated scale. At the same time the amplitude of the sync pulse can be read from the lower graduated scale.

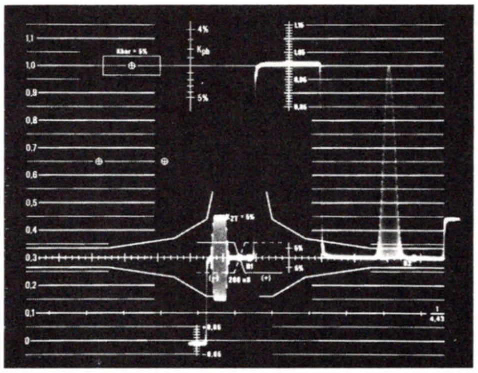


Figure 6. *Check of video level.*

References:

1: BBC and IBA: Specification of Television Standards for 625-Line System I Transmissions.

2: CMTT Document CMTT/187-E, Measurement of insertion gain by means of insertion of test line signals. November 1973.

3: CMTT Document CMTT/189-E Measurement of baseline distortion after trailing edges of step function signals. November 1973.

Appendix: Additional Measurements

Part 7. Check of Time Calibration (PAL Signal)

Controls:	MAG	x 50
	DISPLAY	10 μs/div or 5 μs/div
	LINE SELECTOR	DIG; any convenient line
	FIELD	1 and 3. or 2 and 4
	SYNC	INT; AFC or DIRECT

The time calibration of the waveform monitor with a PAL signal may be quickly and conveniently checked against a video signal by the following procedure. Set the controls as indicated, and rotate the HORIZONTAL POSITION control until the burst near the start of the trace is displayed as in Figure 7. In spite of the low repetition rate the crossover points of the superimposed sine waves will be quite clearly defined. It should then be possible to match these against the graduations provided for the purpose on the 0.1 graticule line. If any appreciable error is noticed, reference should be made to the instrument manual.

With an NTSC signal, due to the absence of the 25 Hz offset found with PAL, there is, of course, no need to use a 2-field display rate.

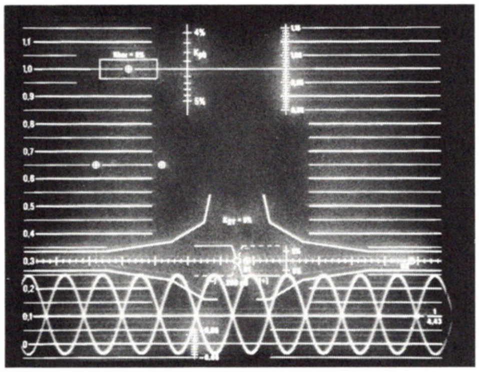


Figure 7. *Check of time calibration (PAL).*

Part 8. Measurement of Time of Fall of Bar

Controls:	MAG	x 50
	DISPLAY	5 μs/div
	LINE SELECTOR	DIG or 15 LINES according to test signal
	FIELD	to suit test signal

(note: with a full-field test signal the 15 LINES facility provides a useful increase in brightness).

In some countries it has been the practice to check the performance of equipment and links up to and beyond the nominal upper video frequency by the use of a 1T bar. This is preferred since the faster decrease in amplitude of its higher harmonics produces less severe ringing than is the case with the 1T pulse, and the resultant waveforms are considered to be easier to interpret.

In particular, the time of rise or fall of the 1T bar provides some indication of the equivalent rectangular bandwidth of the equipment under test, although the derivation of an exact figure from the output waveform is not straightforward unless the passband is Gaussian in shape.

The measurement of the time of fall of a bar waveform in the form of a video waveform is carried out as follows. Set the controls as given above and rotate the HORIZONTAL POSITION control until the trailing edge of the bar is within the display area. Adjust the gain so that the top and bottom of the bar fit exactly between the 0 and 1.0 graticule lines, then position the display so that the bottom of the bar lies on the 0.2 line, and at the same time the trailing edge coincides with the intersection of the 1.1 line and the graduated scale (Figure 8). The time of fall can then be read from the horizontal spacing between the small vertical 5% scale, and the point where the bar edge cuts the 0.3 graticule line.

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CHARACTERISTICS

SCALE FACTOR—INPUT A and B 1.0 Volts Full Screen 1 ± 3 mV, 0.5 Volts Full Screen ± 15 mV, 0.2 V/F Screen ± 6 mV.

Ratio: INPUT A to INPUT B 1, ± 0.002, to 1, AUX VIDEO IN to INPUT A 1.5 ± 0.3 dB.

GAIN—INPUT A to AUX VIDEO OUT 1, ± 0.005, INPUT A to PIX MONITOR OUT 1, + 0.02.

VARIABLE VOLTS FULL SCALE RANGE—Input signals between 0.7 volts and 2.0 volts can be adjusted to 1 volt equivalent display height.

Maximum Input Signal—for inspecification operation of AUX VIDEO OUT and PIX OUT. AC CPL'D: INPUT A and B 2.0 V P-P at any APL—Display distortion. 1.0 V P-P at any APL if both AUX VIDEO OUT and PIX OUT are terminated for distortion-free signal at those outputs.
DC CPL'D: INPUT A and B ± 1.5 V, DC ± Peak AC, AUX VIDEO IN ± 1.5 V, DC ± Peak AC.

Maximum Output DC Voltage, AUX VIDEO OUT and PIX MONITOR OUT into 75 Ω—± 0.5 V DC.
Common Mode Rejection Ratio (A-B)—60 Hz ≥ 46 dB, 15 kHz ≥ 46 dB, 4.43 MHz ≥ 34 dB.

Frequency Response—FLAT including: INPUT A or INPUT B Through AUX VIDEO OUT or PIX MONITOR OUT from 50 kHz Reference: 50 kHz to 5 MHz ± 0.5%, 5 MHz to 10 MHz + 0.5%, −3%. IRE: Conforms to IRE 1958 standard 23S-1. Attenuation at 4.43 MHz, ≥ 22 dB. LOW PASS: Attenuation ≥ 14 dB, 500 kHz and above. 3.58 MHz ± 1% of FLAT at 3.58 MHz, 3 dB down at 3.1 to 3.4 MHz and 3.8 to 4.0 MHz. 4.43 MHz ± 1% of FLAT at 4.43 MHz, 3 dB down at 3.9 to 4.1 MHz and 4.7 to 4.9 MHz. DIFF'D STEPS: Permits amplitude comparisons of risers on stair-step signal with automatic gain increase of 5 times, attenuation ≤ 2 dB from 0.4 to 0.5 MHz, attenuation ≥ 20 dB at 15 kHz and 2 MHz, attenuation ≥ 40 dB at 3.58 MHz and 4.43 MHz.

Linear Waveform Distortion — Pulse Preshoot, Pulse Overshoot, and Pulse Ringing ≤ 0.5% of applied pulse amplitude. 25 μs Bar Tilt ≤ 0.5%, Field Square Wave Tilt ≤ 1%, Pulse to Bar Ratio 0.99:1 to 1.01:1 or 0.99 to 1.01:1.

Non-Linear Waveform Distortion — Differential Gain Displayed ≤ 0.5% at any APL, AUX VIDEO OUT and PIX MONITOR OUT ≤ 0.25% at any APL. Differential Phase—AUX VIDEO OUT and PIX MONITOR OUT ≤ 0.25° at any APL.

DC RESTORER—Mains Hum Attenuation, Slow ≤ 10%, Fast ≥ 26 dB. Shift caused by Presence or Absence of Burst ≤ 1 IRE or 7 mV.

Return Loss (With 75 Ω Termination)—INPUT A or B ≥ 40 dB, DC to 5 MHz, AUX VIDEO IN, AUX Video OUT, or PIX MONITOR OUT ≥ 34 dB, DC to 5 MHz.

Vertical Overscan—for 1 V Peak-to-Peak Composite Video Signal all specifications are valid at 1.0, 0.5, and 0.2 volts FULL SCALE, and any vertical position setting to 5 MHz.

Calibrator Accuracy—1 V ± 0.2%, 714 mV and 700 mV ± 0.5%.

Timebase Accuracy and Linearity—5 μs/DIV and 10 μs/DIV Accuracy Over Center 10 Div ± 1%. Linearity Overall ± 1%.

Magnified Timing and Linearity—For center 10 divisions of unmagnified sweep: ± 2% accuracy, ± 2% linearity.

2 FIELD Sweep Length and Linearity—12.7 div, ± 0.5 div.

FIELD SELECTOR—Positive selection of ODD (2 & 4) or EVEN (1 & 3) in 525/60 Systems. Display starts on selected field. Positive selection of 1, 2, 3, or 4, or 1 & 3, 2 & 4, in 625/50 Systems. Display starts on selected field.

LINE SELECTOR—VARIABLE Range: From approximately line 20 of the selected field to approximately line 8 of the next complementary field (example, line 20 or field 1, to line 8 of field 3). Lines intensified by the strobe in 2 FIELD display are the lines displayed in 5 μs/DIV or 10 μs/DIV. DIGITAL: Selects line 9/322 to line 22/335. 15 LINE: Identical to VARIABLE, except that 15 successive lines are displayed. ALL FIELDS: Time overlay of all fields any setting of the DISPLAY switch.

Sync Input Requirements—INT 200 mV peak-to-peak to 2 V peak-to-peak composite video. EXT 400 mV peak-to-peak to 2 V peak-to-peak composite video, 200 mV peak-to-peak to 8 V peak-to-peak composite sync. Return loss ≥ 46 dB down to 5 MHz.

Maximum Jitter with 1 V Peak-to-Peak Composite Video + (−26) dB White Noise—Direct 250 ns, AFC 90 ns .

Maximum Jitter with Missing Horizontal Sync Pulses—≤ 15 ns/missing sync pulse (maximum of 10 consecutive horizontal sync pulses missing).

50 Hz/60 Hz Recognition—Automatically recognizes 50 Hz or 60 Hz scan in dual standard instrument.

Horizontal Trigger—AFC: Horiz. Frequency 15.750 ± 200 Hz, Lock-In Time ≤ 1 sec. Maximum Jitter with Respect to Input Sync 10 ns—Input composite Video or Composite Sync from a 140-series Generator, 12 ns-Variable APL, 12 ns—Variable APL & 4 V rms Hum, 30 ns—Variable APL & 4 V rms Hum + (−36) dB White Noise. Jitter Reduction with Respect to White Noise ≥ 8 dB.

DIRECT—Horiz. Frequency Range ≤ 20 kHz. Maximum Jitter with Respect to Input Sync 12 ns—input Composite Video or Composite Sync from a 140-series Generator, 20 ns—Variable APL, 20 ns—Variable APL & 4 V rms Hum, 90 ns —Variable APL & 4 V Tum ± (−36) dB White Noise.

EXTERNAL HORIZ IN — Sensitivity 0.5 V/div, Linearity ± 1%.

RGB/YRGB J9036—RGB Sweep Length Internally selected for ⅓ normal sweep. YRGB Sweep Length internally selected for ¼ normal sweep.

WAVEFORM COMPARISON—LOCATE: Range sufficient to place LOCATE indication any place on 5 μs/DIV, or unmagnified 10 μs/DIV sweeps. OVERLAY: Range sufficient to overlay any selected portion of 5 μs/DIV or unmagnified 10 μs/DIV on any other portion.

LINE STROBE OUT—Strobe output of line or lines selected by VARIABLE, 15 LINE, or DIGITAL line selector modes and the DISPLAY switch. TTL-amplitude, ac-coupled. Time Constant = 1 μF, 10 kΩ.

OPTION 1
10X Probe Channel—Scale Factor adjustable to 1 V peak-to-peak equivalent display height, GAIN Range ± 10%. Gain to AUX VIDEO: Unity, ± 3%, with gain adjusted for 1 V peak-to-peak equivalent display height. Tilt ≤ 5% on 50 Hz square wave, High Frequency Response ± 1%, 25 Hz to 5 MHz. ± 3%, 5 MHz to 10 MHz. Referenced to 50 kHz. Differential Phase ≤ 0.25 at any APL. Differential Gain ≤ 0.25% at any APL. Input Resistance 1 MΩ, ± 2%, not including probe. Input RC Product 20 μs, ± 0.5%, not including probe. BNC connector accepts most TEKTRONIX probes. P6065A probe recommended.

10X Probe Calibrator—Output Voltage 1.000 V ± 0.005 V or 0.995 to 1.005 V.

OPTION 4
TAPE T.W. SYNC Input—NTSC: Syncs to either a standard negative-going composite sync pulse of 3.5 V to 4.5 V in amplitude, or a 240 Hz negative-going tape recorder pulse, 1.5 V to 4.5 V in amplitude, 2,083 ms in width, and 4.166 ms in period. PAL: Syncs to negative-going 200 Hz tape recorder pulse, 1.5 to 4.5 V in amplitude 2.5 ms in width, and 5 ms in period.

Mains Voltage—Ranges: 100 VAC, 110 VAC, 120 VAC, 200 VAC, 220 VAC, 240 VAC ± 10%. Frequency: 48 Hz to 62 Hz, Max Power Consumption 75 W.

OPERATING TEMPERATURE—0°C to 50°C.

Dimensions and Weights

1480 C Series		
Height	8.25 in	21 cm
Width	8.50 in	21.6 cm
Depth	16.95 in	43.0 cm
Net Weight	21.5 lb	9.81 kg
Domestic shipping weight	≈28.5 lb	≈12.9 kg
Export-packed weight	≈41.5 lb	≈18.8 kg

Two 1480 C Series Waveform Monitors can be mounted side-by-side, or one mounted alongside an associated picture monitor in a standard 19-inch rack or console.

1480 R Series		
Height	5.25 in	13.3 cm
Width	19.0 in	48.2 cm
Rack Depth	18.0 in	45.7 cm
Net Weight	24.6 lb	11.2 kg
Domestic shipping weight	≈53.1 lb	≈24.1 kg
Export-packed weight	≈75.1 lb	≈34.1 kg

Instrument fits standard 19-inch rack.

ORDERING INFORMATION
1480C NTSC Waveform Monitor
1480R NTSC Waveform Monitor
1481C PAL Waveform Monitor
1481R PAL Waveform Monitor
1482C PAL M Waveform Monitor
1482R PAL M Waveform Monitor
1485C PAL/NTSC Dual Standard Waveform Monitor
1485R PAL/NTSC Dual Standard Waveform Monitor

Option 01 1 megohm, 20 pf probe input (probe not included)
Suggested Probe
P6065A 10X Probe, 6-ft, Order 010-6065-13
9-ft, Order 010-6105-05

Option 02 With carrying Case (Cabinet Version Only)

Option 03 With Blank CRT

Option 07 Slow Sweep

Option 08 Adds capability of recognizing four field sequence of SECAM (1481C, 1481R, 1485C, 1485R only)

TEKTRONIX Automatic Correction Products are also available for 525/60 NTSC systems.

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application notes

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no. 13

Time Base Fold Back, A Novel Improvement Over Double Triggering for Video Testing

By Charles W. Rhodes

In video testing, one is often comparing the amplitude of a test signal with the reference level provided by still another test signal. For example, the measurement of pulse-to-bar ratio using the 2T sine squared pulse and the line bar, or measuring chrominance-to-luminance gain equality with the modulated sine squared pulse and line bar. In both these cases, the amplitude of the pulse is measured with respect to the **midpoint** of the line bar. Where line time luminance distortion is present, which is not untypical in long distance video transmission systems, it is important to measure with respect to the bar's midpoint. This is recognized in CCIR, CMMT and other standard measuring procedures.

The usual measurement procedure is to adjust vertical gain so that bar midpoint equals 1.00 (CCIR scale) or 100 IRE units for NTSC signals, and then measure the amplitude of the pulse. At best this is an estimating process and involves the intermediate step, always subject to error, of setting gain correctly. In Figure 1, pulse-to-bar-ratio ≃ 0.965, chrominance-to-luminance gain inequality ~ 12.5%.

A far more accurate, faster and convenient procedure dispenses with critical gain setting of bar midpoint to the graticule, and offers a direct comparison of pulse-to-bar midpoint amplitudes. This is shown in Figure 2.
Such displays are especially useful when either high precision in measurement is desired, or where exact equalization is being made on circuits.

Some laboratory oscilloscopes could provide such a display by the well known "double triggering" mode. In his book "Television Measurement Techniques"[1] L. E. Weaver says ". . . greater accuracy is obtained in measurement of $K_{p,b}$ (Pulse-to-bar) if the waveform monitor can be double triggered so that the centre of the bar appears vertically above the peak of the pulse." However, as such scopes were not designed to do this, it is just a bit tricky and inconvenient and in the case of in-service measurements, using insertion test signals, (VITS), conventional "double triggering" cannot be used at all.

Tektronix, recognizing the importance of this kind of measurement capability, has provided its new 1480 Series Waveform Monitor with "time base foldback". This new feature is easy to use and works on insertion test signals (VITS) which conventional "double triggering" cannot do. It is not limited to in-service testing, it is very valuable in laboratory measurements where high precision is required.

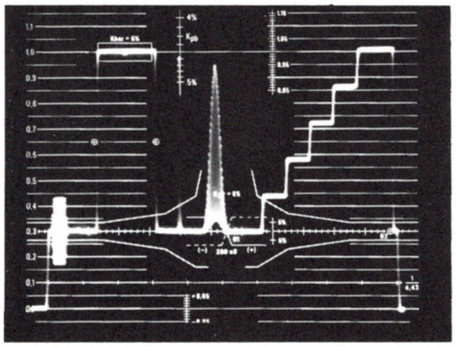

Figure 1.

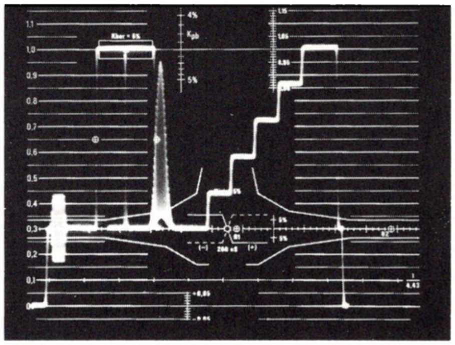

Figure 2.

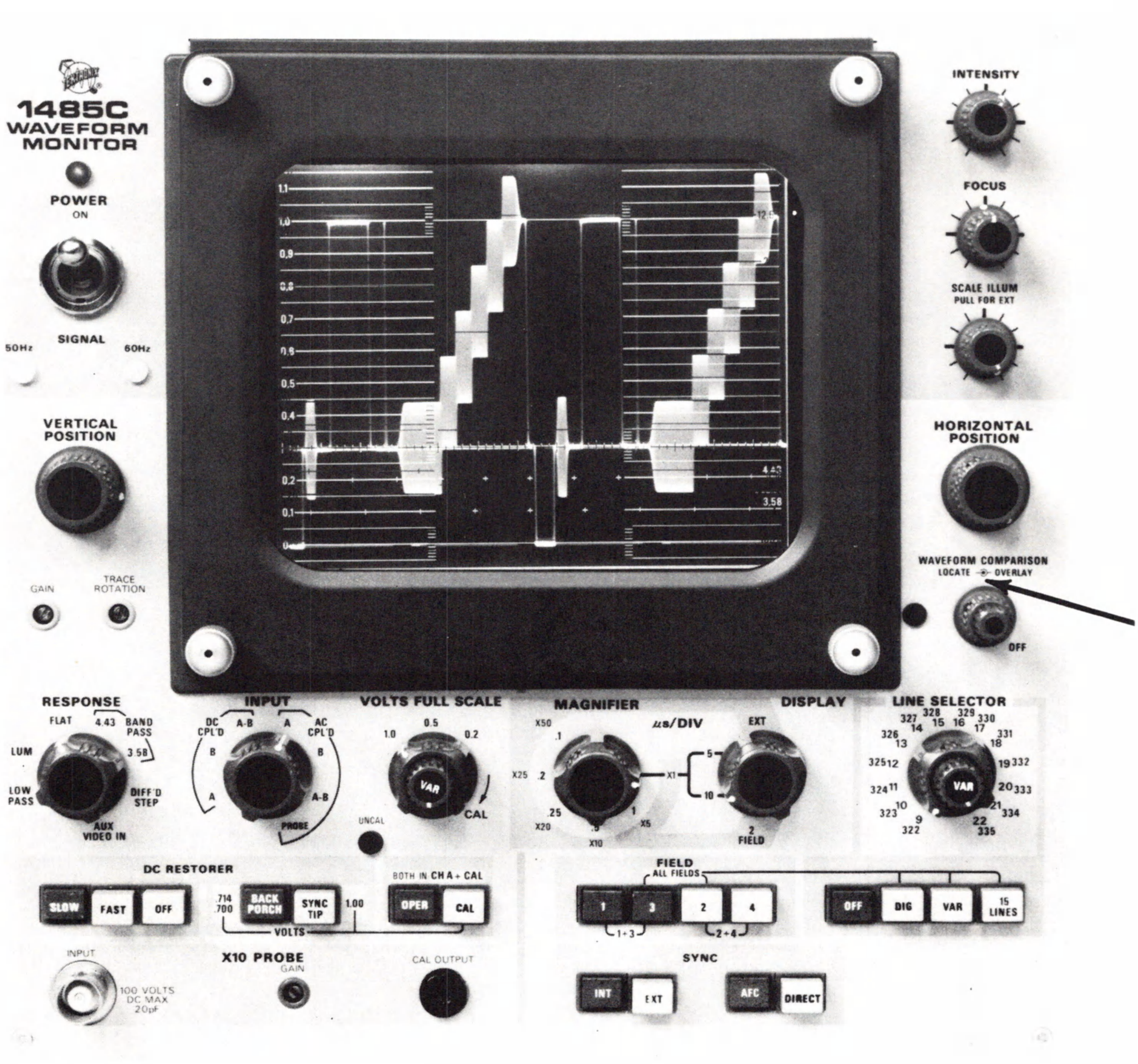
1485C
WAVEFORM
MONITOR
POWER
ON
SIGNAL
50Hz
60Hz
VERTICAL
POSITION
GAIN
TRACE
ROTATION
INTENSITY
FOCUS
SCALE ILLUM
PULL FOR EXT
HORIZONTAL
POSITION
WAVEFORM COMPARISON
LOCATE
OVERLAY
OFF
RESPONSE
FLAT
4.43
BAND PASS
3.58
LUM
LOW PASS
DIFF'D STEP
AUX VIDEO IN
INPUT
DC CPL'D
A-B
A
AC CPL'D
B
PROBE
VOLTS FULL SCALE
1.0
0.5
0.2
VAR
CAL
UNCAL
MAGNIFIER
µs/DIV
X50
X25
X20
X10
X5
X1
DISPLAY
EXT
5
10
2 FIELD
LINE SELECTOR
VAR
DC RESTORER
SLOW
FAST
OFF
.714
.700
BACK PORCH
SYNC TIP
1.00
VOLTS
BOTH IN CH A + CAL
OPER
CAL
FIELD
ALL FIELDS
1
3
2
4
1+3
2+4
OFF
DIG
VAR
15 LINES
INPUT
100 VOLTS DC MAX 20pF
X10 PROBE
GAIN
CAL OUTPUT
SYNC
INT
EXT
AFC
DIRECT
12.5
4.43
3.58

Figure 3.

Under the front panel label WAVEFORM COMPARISON two concentric controls, LOCATE and OVERLAY control the time base foldback circuit, see Figure 3. A red warning lamp is "ON" whenever the foldback is switched ON. A switch on the OVERLAY, outer concentric control (clockwise end) enables the foldback circuit and turns on the lamp as the control is rotated counter-clockwise.

To indicate precisely where the foldback will occur in time, an (intensity) marker is provided, whenever the circuit is operating. Figure 4 shows the marker which is controlled by the LOCATE control.

The other (inner) control knob labeled, OVERLAY, moves the portion of the waveform to the right of the (intensity) marker. For example, the line bar lies to the left of the sine^2 pulse as shown in Figure 4, but the sine^2 pulse is easily moved to the left for comparison with the bar, which remains stationary. Once the sine^2 pulse is positioned at bar midpoint, very small differences in pulse and bar amplitudes can be resolved by

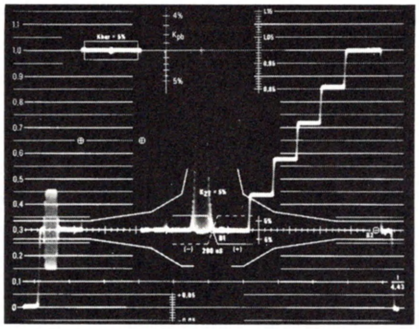

Figure 4.

magnifying the signal vertically. For example, a 1% difference in 2T pulse-to-bar ratio equals 1 IRE unit (7 mV CCIR) in a 1 volt, full scale deflection. This is barely discernible, but with X5 vertical expansion, a 1% pulse-to-bar amplitude inequality is displayed as a difference of 5 IRE units, as shown in Figure 5. A 1% difference in pulse-to-bar amplitudes is approximately $K_{pb} = 0.25\%$. If a K_{pb} of 0.25% can be displayed as 5 IRE units, then one may easily resolve K_{pb} to, say 0.1% K.

For a measurement of chrominance-luminance gain inequality, a modulated sine^2 pulse-to-bar amplitude ratio of 1% equals 2% chrominance-luminance gain inequality. With X5 vertical expansion this small gain inequality (or less) is easily and accurately resolved.

Line time luminance nonlinearity is a measurement in which the relative amplitudes of the five differentiated step risers (spikes) are compared. See Figure 6. The differentiation of the risers provides a sensitive measurement of non-linear distortions affecting the luminance signal.

CCIR defines this distortion as $(1 - \frac{m}{M})$, where m equals the amplitude of the least spike and M the amplitude of the greatest spike.

In Figure 7, the time base foldback feature of TEKTRONIX 1480 Series is used to compare spike amplitudes. Here the least amplitude spike and greatest amplitude spikes are overlaid for easy comparison.

Line time distortion, e.g.: Tilt of the line bar, can be very accurately measured by comparing the amplitude of any part of the line bar with its midpoint amplitude. Here again, the calibrated vertical expansion of TEKTRONIX 1480 Series, combines with time base foldback to provide accurate resolution of small distortions. Figure 8 shows the line time distortion on bar top. Utilizing the Tektronix developed time base foldback and calibrated X5 vertical expansion it is possible to resolve 0.25% distortion, or K = 0.25%.

Distortions as small as those cited above, do not represent significant picture impairments. However, a series of cascaded links each contributing these distortions will, at the downstream end, provide a degraded picture. Since these distortions are small on a per-link basis, they prove hard to measure without use of calibrated vertical expansion and time base foldback. Together, these features of TEKTRONIX 1480 Series Waveform Monitor provide state-of-the-art measurement capabilities for both laboratory and operational work.

[1] Television Measurement Techniques, by L. E. Weaver; Peter Peregrinus Ltd., 1971

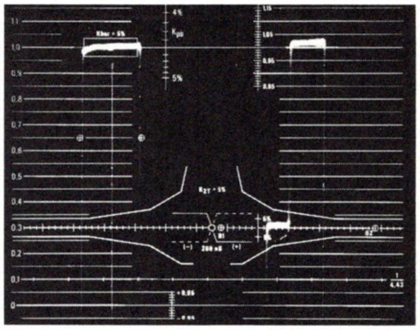

Figure 5.

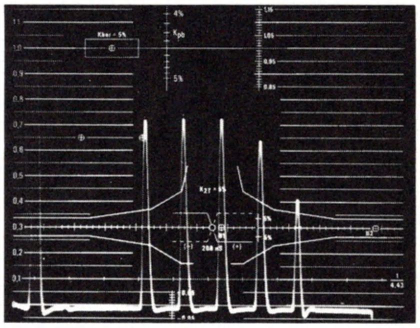

Figure 6.

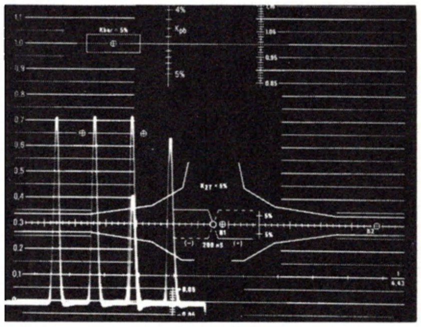

Figure 7.

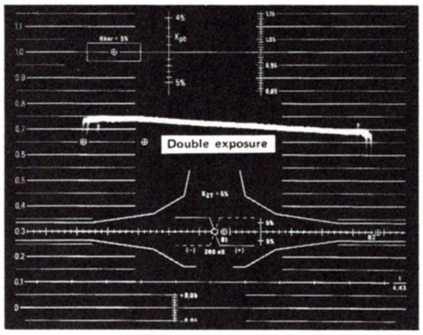

Figure 8.

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5-77 AX-3071-1

CHARACTERISTICS

SCALE FACTOR—INPUT A and B 1.0 Volts Full Screen 1 ± 3 mV, 0.5 Volts Full Screen ± 15 mV, 0.2 V/F Screen ± 6 mV.

Ratio: INPUT A to INPUT B 1, ± 0.002, to 1, AUX VIDEO IN to INPUT A 1.5 ± 0.3 dB.

GAIN—INPUT A to AUX VIDEO OUT 1, ± 0.005, INPUT A to PIX MONITOR OUT 1, + 0.02.

VARIABLE VOLTS FULL SCALE RANGE—Input signals between 0.7 volts and 2.0 volts can be adjusted to 1 volt equivalent display height.

Maximum Input Signal—for inspecification operation of AUX VIDEO OUT and PIX OUT. AC CPL'D: INPUT A and B 2.0 V P-P at any APL—Display distortion. 1.0 V P-P at any APL if both AUX VIDEO OUT and PIX OUT are terminated for distortion-free signal at those outputs.
DC CPL'D: INPUT A and B ± 1.5 V, DC ± Peak AC, AUX VIDEO IN ± 1.5 V, DC ± Peak AC.

Maximum Output DC Voltage, AUX VIDEO OUT and PIX MONITOR OUT into 75 Ω—± 0.5 V DC.
Common Mode Rejection Ratio (A-B)—60 Hz ≥ 46 dB, 15 kHz ≥ 46 dB, 4.43 MHz ≥ 34 dB.

Frequency Response—FLAT including: INPUT A or INPUT B Through AUX VIDEO OUT or PIX MONITOR OUT from 50 kHz Reference: 50 kHz to 5 MHz ± 0.5%, 5 MHz to 10 MHz + 0.5%, −3%. IRE: Conforms to IRE 1958 standard 23S-1. Attenuation at 4.43 MHz, ≥ 22 dB. LOW PASS: Attenuation ≥ 14 dB, 500 kHz and above. 3.58 MHz ± 1% of FLAT at 3.58 MHz, 3 dB down at 3.1 to 3.4 MHz and 3.8 to 4.0 MHz. 4.43 MHz ± 1% of FLAT at 4.43 MHz, 3 dB down at 3.9 to 4.1 MHz and 4.7 to 4.9 MHz. DIFF'D STEPS: Permits amplitude comparisons of risers on stairstep signal with automatic gain increase of 5 times, attenuation ≤ 2 dB from 0.4 to 0.5 MHz, attenuation ≥ 20 dB at 15 kHz and 2 MHz, attenuation ≥ 40 dB at 3.58 MHz and 4.43 MHz.

Linear Waveform Distortion — Pulse Preshoot, Pulse Overshoot, and Pulse Ringing ≤ 0.5% of applied pulse amplitude. 25 μs Bar Tilt ≤ 0.5%, Field Square Wave Tilt ≤ 1%, Pulse to Bar Ratio 0.99:1 to 1.01:1 or 0.99 to 1.01:1.

Non-Linear Waveform Distortion — Differential Gain Displayed ≤ 0.5% at any APL, AUX VIDEO OUT and PIX MONITOR OUT ≤ 0.25% at any APL. Differential Phase—AUX VIDEO OUT and PIX MONITOR OUT ≤ 0.25 at any APL.

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Return Loss (With 75 Ω Termination)—INPUT A or B ≥ 40 dB, DC to 5 MHz, AUX VIDEO IN, AUX Video OUT, or PIX MONITOR OUT ≥ 34 dB, DC to 5 MHz.

Vertical Overscan—for 1 V Peak-to-Peak Composite Video Signal all specifications are valid at 1.0, 0.5, and 0.2 volts FULL SCALE, and any vertical position setting to 5 MHz.

Calibrator Accuracy—1 V ± 0.2%, 714 mV and 700 mV ± 0.5%.

Timebase Accuracy and Linearity—5 μs/DIV and 10 μs/DIV Accuracy Over Center 10 Div ± 1%, Linearity Overall ± 1%.

Magnified Timing and Linearity—For center 10 divisions of unmagnified sweep: ± 2% accuracy, ± 2% linearity.

2 FIELD Sweep Length and Linearity—12.7 div, ± 0.5 div.

FIELD SELECTOR—Positive selection of ODD (2 & 4) or EVEN (1 & 3) in 525/60 Systems. Display starts on selected field. Positive selection of 1, 2, 3, or 4, or 1 & 3, 2 & 4, in 625/50 Systems. Display starts on selected field.

LINE SELECTOR—VARIABLE Range: From approximately line 20 of the selected field to approximately line 8 of the next complementary field (example, line 20 or field 1, to line 8 of field 3). Lines intensified by the strobe in 2 FIELD display are the lines displayed in 5 μs/DIV or 10 μs/DIV. DIGITAL: Selects line 9/322 to line 22/335. 15 LINE: Identical to VARIABLE, except that 15 successive lines are displayed. ALL FIELDS: Time overlay of all fields any setting of the DISPLAY switch.

Sync Input Requirements—INT 200 mV peak-to-peak to 2 V peak-to-peak composite video. EXT 400 mV peak-to-peak to 2 V peak-to-peak composite video, 200 mV peak-to-peak to 8 V peak-to-peak composite sync. Return loss ≥ 46 dB down to 5 MHz.

Maximum Jitter with 1 V Peak-to-Peak Composite Video + (−26) dB White Noise—Direct 250 ns, AFC 90 ns .

Maximum Jitter with Missing Horizontal Sync Pulses—≤ 15 ns/missing sync pulse (maximum of 10 consecutive horizontal sync pulses missing).

50 Hz/60 Hz Recognition—Automatically recognizes 50 Hz or 60 Hz scan in dual standard instrument.

Horizontal Trigger—AFC: Horiz. Frequency 15,750 ± 200 Hz, Lock-In Time ≤ 1 sec. Maximum Jitter with Respect to Input Sync 10 ns—Input composite Video or Composite Sync from a 140-series Generator, 12 ns-Variable APL, 12 ns—Variable APL & 4 V rms Hum, 30 ns—Variable APL & 4 V rms Hum + (−36) dB White Noise. Jitter Reduction with Respect to White Noise ≥ 8 dB.

DIRECT—Horiz. Frequency Range ≤ 20 kHz. Maximum Jitter with Respect to Input Sync 12 ns—input Composite Video or Composite Sync from a 140-series Generator, 20 ns—Variable APL, 20 ns—Variable APL & 4 V rms Hum, 90 ns —Variable APL & 4 V Tum ± (−36) dB White Noise.

EXTERNAL HORIZ IN — Sensitivity 0.5 V/div, Linearity ± 1%.

RGB/YRGB J9036—RGB Sweep Length Internally selected for ⅓ normal sweep. YRGB Sweep Length internally selected for ¼ normal sweep.

WAVEFORM COMPARISON—LOCATE: Range sufficient to place LOCATE indication any place on 5 μs/DIV, or unmagnified 10 μs/DIV sweeps. OVERLAY: Range sufficient to overlay any selected portion of 5 μs/DIV or unmagnified 10 μs/DIV on any other portion.

LINE STROBE OUT—Strobe output of line or lines selected by VARIABLE, 15 LINE, or DIGITAL line selector modes and the DISPLAY switch. TTL-amplitude, ac-coupled. Time Constant ≈ 1 μF, 10 kΩ.

OPTION 1
10X Probe Channel—Scale Factor adjustable to 1 V peak-to-peak equivalent display height. GAIN Range ± 10%. Gain to AUX VIDEO: Unity, ± 3%, with gain adjusted for 1 V peak-to-peak equivalent display height. Tilt ≤ 5% on 50 Hz square wave, High Frequency Response ± 1%, 25 Hz to 5 MHz. ± 3%, 5 MHz to 10 MHz. Referenced to 50 kHz. Differential Phase ≤ 0.25 at any APL. Differential Gain < 0.25% at any APL. Input Resistance 1 MΩ ± 2%, not including probe. Input RC Product 20 μs ± 0.5%, not including probe. BNC connector accepts most TEKTRONIX probes. P6065A probe recommended.

10X Probe Calibrator—Output Voltage 1.000 V ± 0.005 V or 0.995 to 1.005 V.

OPTION 4
TAPE T.W. SYNC Input—NTSC: Syncs to either a standard negative-going composite sync pulse of 3.5 V to 4.5 V in amplitude, or a 240 Hz negative-going tape recorder pulse, 1.5 V to 4.5 V in amplitude, 2,083 ms in width, and 4.166 ms in period. PAL: Syncs to negative-going 200 Hz tape recorder pulse, 1.5 to 4.5 V in amplitude 2.5 ms in width, and 5 ms in period.

Mains Voltage—Ranges: 100 VAC, 110 VAC, 120 VAC, 200 VAC, 220 VAC, 240 VAC ± 10%. Frequency: 48 Hz to 62 Hz, Max Power Consumption 75 W.

OPERATING TEMPERATURE—0°C to 50°C.

Dimensions and Weights

1480 C Series		
Height	8.25 in	21 cm
Width	8.50 in	21.6 cm
Depth	16.95 in	43.0 cm
Net Weight	21.5 lb	9.81 kg
Domestic shipping weight	≈28.5 lb	≈12.9 kg
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Height	5.25 in	13.3 cm
Width	19.0 in	48.2 cm
Rack Depth	18.0 in	45.7 cm
Net Weight	24.6 lb	11.2 kg
Domestic shipping weight	≈53.1 lb	≈24.1 kg
Export-packed weight	≈75.1 lb	≈34.1 kg

Instrument fits standard 19-inch rack.

ORDERING INFORMATION

1480C NTSC Waveform Monitor
1480R NTSC Waveform Monitor
1481C PAL Waveform Monitor
1481R PAL Waveform Monitor
1482C PAL M Waveform Monitor
1482R PAL M Waveform Monitor
1485C PAL/NTSC Dual Standard Waveform Monitor
1485R PAL/NTSC Dual Standard Waveform Monitor

Option 01	1 megohm, 20 pf probe input (probe not included) Suggested Probe P6065A 10X Probe, 6-ft, Order 010-6065-13 9-ft, Order **010-6105-05**
Option 02	With carrying Case (Cabinet Version Only)
Option 03	With Blank CRT
Option 07	Slow Sweep
Option 08	Adds capability of recognizing four field sequence of SECAM (1481C, 1481R, 1485C, 1485R only)

TEKTRONIX Automatic Correction Products are also available for 525/60 NTSC systems.

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application notes

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no.14

Superimposing Alternate Field ITS to Improve In-Service Testing

Since their introduction, the use of Insertion Test Signals for in-service measurement has revolutionized television distribution system measurement techniques. For the first time it became possible to test a distribution system while it was in use. The new TEKTRONIX 1480 Series Waveform Monitor is especially designed to even further these techniques. One of the major innovative display modes added to the 1480 Series is ALL FIELDS which superimposes all, or part of alternate fields. This new feature presents some very distinct advantages:

1. Simultaneous viewing of all four International Insertion Test Signals (or other selected interval lines).
2. Comparison of ITS signals applied at separate points.
3. An in-service method of displaying field time distortions.

Simultaneous ITS

Methods of in-service testing, in common use, all require accurate Insertion Test Signals located on specific field blanking interval lines. Because of this requirement the International Radio Consultative Committee, C.C.I.R., has established 4 lines for internationally defined test signals. In addition lines are assigned, and used, for national test signals. Because of their importance to the overall quality of television processing circuits, ITS are being more closely monitored. The 1480 Series Waveform Monitor ALL FIELDS display is an ideal method of observing these signals. When used in the 10 μ second per division (2 H) sweep rate all four of the international Insertion Test Signals (lines 17, 18, 330 and 331) can be viewed at once. See Figure 1.

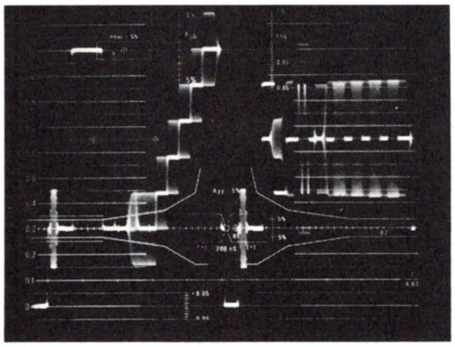

Figure 1. *All 4 international insertion test signals displayed simultaneously.*

Comparing ITS

It is relatively easy to assess the distortion of the entire distribution system by K-rating it with the Insertion Test Signal, added at the point of origin. However, this does not isolate individual problem areas. Although not new, the idea of inserting test signals at different points and comparing them takes on a new dimension when the test signal can be directly overlaid for comparison.

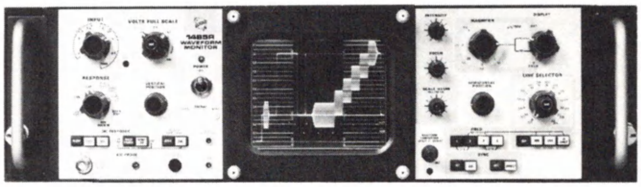

Figure 2. *1485R Front Panel.*

This display mode is selected through the ALL FIELDS selection located at the lower right corner of the front panel. The novel circuitry involved makes it possible to overlay the even and odd fields to display a single line, pair of adjacent lines or both fields (displayed as a single field in the 2 FIELD DISPLAY mode).

Using this display technique opens up an outstanding test method for distribution system analysis. All that is required, in addition to the ALL FIELDS display, is a method to delete the original Insertion Test Signal on one field and reinsert an identical test signal. Precautions must be taken that the outputs of any Insertion Test Signal generators used for this type of measurement are as closely matched as current technology permits. In addition the coincidence of the Insertion Test Signals is extremely important. The TEKTRONIX 148 Insertion Test Signal Generator has a front panel screwdriver adjustment, labeled INSERTION DELAY, that may be adjusted for coincidence. Matching generator is in itself an excellent use of the 1480 Series overlayed fields display with one generator inserting in even field interval, while the other is inserting only in the odd field intervals.

For purposes of illustration, the United Kingdom Insertion Test Signal 1 (lines 19 and 332) is used and a determination as to which line will traverse the entire system and which will be deleted and subsequently reinserted has to be made. Arbitrarily, for purposes of illustration, Line 19 (even fields) is the system reference, while Line 332 (odd fields) is used for the reinserted test signal.

The usefulness of this technique is enhanced by its universality. The size of the system under test can be anywhere from a Studio-to-Transmitter Link to a transcontinental network. In addition, since only the difference between the Insertion Test Signals is to be considered, any point in the system can be selected for the reinsertion point, with monitoring at any downstream point desired. This leaves one major consideration; the monitoring operator must know where reinsertion is occurring, but with modern distribution systems this is no problem.

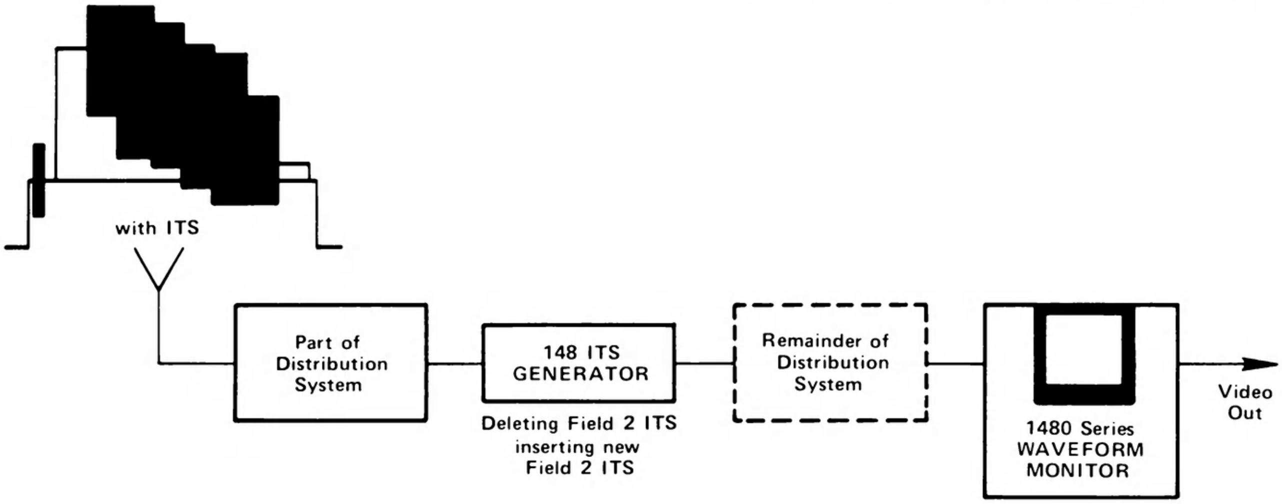
with ITS
Part of Distribution System
148 ITS GENERATOR
Deleting Field 2 ITS inserting new Field 2 ITS
Remainder of Distribution System
1480 Series WAVEFORM MONITOR
Video Out

Figure 3. *Simplified diagram of a distribution system, showing reinsertion of field 2 ITS.*

Now that the test signal assignments have been made, all that remains is the comparison. Since the even field (line 19) test signal has traversed the entire system it will display maximum distortion and should be identified prior to the actual overlaying. When ALL FIELDS is selected any difference is immediately apparent. See Figure 4.

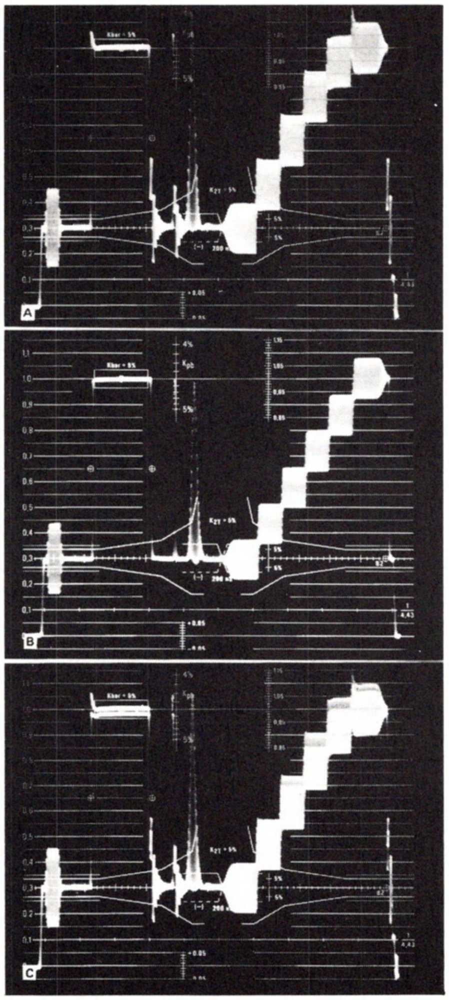

Figure 4. **a.** *Insertion test signal through full system.*
b. *Insertion test signal reinserted.*
c. *Signals a and b overlayed.*

Once the ALL FIELDS display is obtained several options, aside from the obvious visual comparison, remain. One, comparative K-rating, is especially valuable if the monitoring point is physically removed from the point of reinsertion, allowing some degradation of both test signals. Figure 5 shows K_{pb} and K_{2T} of the overlayed test signals, note that both displayed signals are degraded and that three distinct pieces of information are available.

1. Total distribution system distortion (K-rating of the Line 19 test signal).
2. Distortion from the point of reinsertion to the monitoring point (K-rating of the Line 332 test signal).
3. Distortion from the point of origin to the point of reinsertion (difference in the K-ratings).

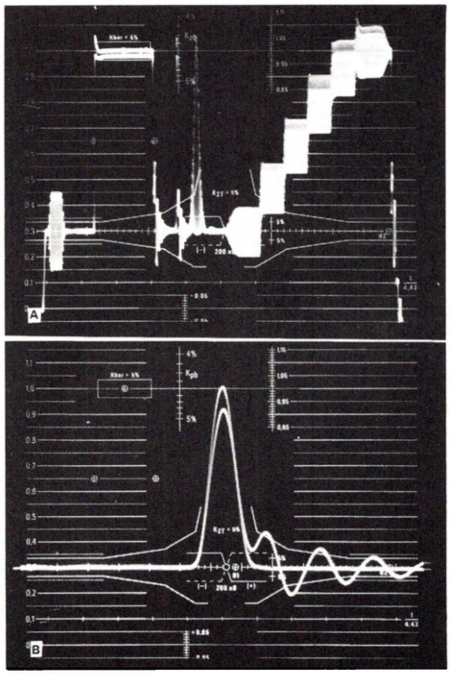

Figure 5. **a.** *K_{pb} of the overlayed ITS.*
b. *K_{2T} of the overlayed ITS.*

Observing Field Time Distortion

It is normally not possible to observe field time distortion on an in-service basis. However, with the ALL FIELDS display mode of the 1480 Series Waveform Monitor it can now be done with relative ease. It should be noted at this time that the most sensitive test signal for this purpose is a 52 μS white bar, however this is not normally an Insertion Test Signal. Figure 6 shows the field time distortion (tilt) of a white bar signal.

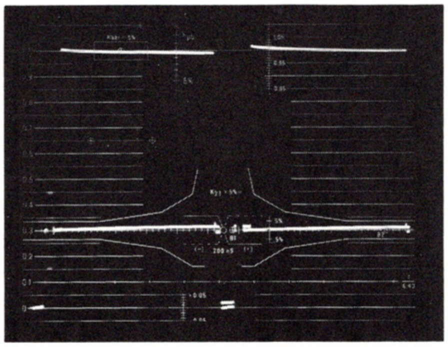

Figure 6. *Field time distortion observed with a white bar.*

To make a similar, though less sensitive, in-service observation one Insertion Test Signal must be deleted. For an example, let line 17 be deleted while lines 18, 330 and 331 continue to carry the assigned test signals. By displaying ALL FIELDS, as shown in Figure 7 observe that lines 18 and 331 display different video levels. This is field time distortion, which may also be thought of as a residue of line 330 energy due to the tilt (field time distortion). Sensitivity of the test is dependent on the energy contained in the test signal; the energy available on line 330 is less than that of a white bar signal.

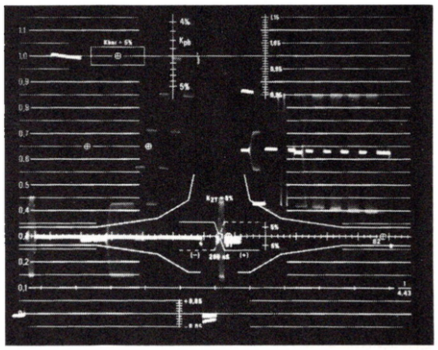

Figure 7. *Field time distortion observed with ITS.*

By comparing the results obtained in Figure 6 and 7 it is obvious that the in-service measurement is less sensitive than using the optimum signal. However, this is still a powerful measurement technique, in that it can be performed in-service, using established test signals.

With the inclusion of ALL FIELDS and the other new display features, covered by the other Application Notes in this series, the 1480 Series Waveform Monitor has widened the area of in-service measurement. Tests that were either impossible or at best estimations, when performed in-service, are now accurate and time saving.

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5-77 AX-3076-1

CHARACTERISTICS

SCALE FACTOR—INPUT A and B 1.0 Volts Full Screen 1 ± 3 mV, 0.5 Volts Full Screen ± 15 mV, 0.2 V/F Screen ± 6 mV.

Ratio: INPUT A to INPUT B 1, ± 0.002, to 1. AUX VIDEO IN to INPUT A 1.5 ± 0.3 dB.

GAIN—INPUT A to AUX VIDEO OUT 1, ± 0.005, INPUT A to PIX MONITOR OUT 1, + 0.02.

VARIABLE VOLTS FULL SCALE RANGE—Input signals between 0.7 volts and 2.0 volts can be adjusted to 1 volt equivalent display height.

Maximum Input Signal—for inspecification operation of AUX VIDEO OUT and PIX OUT. AC CPL'D: INPUT A and B 2.0 V P-P at any APL—Display distortion. 1.0 V P-P at any APL if both AUX VIDEO OUT and PIX OUT are terminated for distortion-free signal at those outputs.
DC CPL'D: INPUT A and B ± 1.5 V, DC ± Peak AC, AUX VIDEO IN ± 1.5 V, DC ± Peak AC.

Maximum Output DC Voltage, AUX VIDEO OUT and PIX MONITOR OUT into 75 Ω—± 0.5 V DC.
Common Mode Rejection Ratio (A-B)—60 Hz ≥ 46 dB, 15 kHz ≥ 46 dB, 4.43 MHz ≥ 34 dB.

Frequency Response—FLAT including: INPUT A or INPUT B Through AUX VIDEO OUT or PIX MONITOR OUT from 50 kHz Reference: 50 kHz to 5 MHz ± 0.5%, 5 MHz to 10 MHz + 0.5%, −3%. IRE: Conforms to IRE 1958 standard 23S-1. Attenuation at 4.43 MHz, ≥ 22 dB. LOW PASS: Attenuation ≥ 14 dB, 500 kHz and above. 3.58 MHz ± 1% of FLAT at 3.58 MHz, 3 dB down at 3.1 to 3.4 MHz and 3.8 to 4.0 MHz. 4.43 MHz ± 1% of FLAT at 4.43 MHz, 3 dB down at 3.9 to 4.1 MHz and 4.7 to 4.9 MHz. DIFF'D STEPS: Permits amplitude comparisons of risers on stairstep signal with automatic gain increase of 5 times, attenuation ≤ 2 dB from 0.4 to 0.5 MHz, attenuation ≥ 20 dB at 15 kHz and 2 MHz, attenuation ≥ 40 dB at 3.58 MHz and 4.43 MHz.

Linear Waveform Distortion — Pulse Preshoot, Pulse Overshoot, and Pulse Ringing ≤ 0.5% of applied pulse amplitude. 25 μs Bar Tilt ≤ 0.5%, Field Square Wave Tilt ≤ 1%, Pulse to Bar Ratio 0.99:1 to 1.01:1 or 0.99 to 1.01:1.

Non-Linear Waveform Distortion — Differential Gain Displayed ≤ 0.5% at any APL, AUX VIDEO OUT and PIX MONITOR OUT ≤ 0.25% at any APL. Differential Phase—AUX VIDEO OUT and PIX MONITOR OUT ≤ 0.25 at any APL.

DC RESTORER—Mains Hum Attenuation, Slow ≤ 10%. Fast ≥ 26 dB. Shift caused by Presence or Absence of Burst ≤ 1 IRE or 7 mV.

Return Loss (With 75 Ω Termination)—INPUT A or B ≥ 40 dB, DC to 5 MHz, AUX VIDEO IN, AUX Video OUT, or PIX MONITOR OUT ≥ 34 dB, DC to 5 MHz.

Vertical Overscan—for 1 V Peak-to-Peak Composite Video Signal all specifications are valid at 1.0, 0.5, and 0.2 volts FULL SCALE, and any vertical position setting to 5 MHz.

Calibrator Accuracy—1 V ± 0.2%, 714 mV and 700 mV ± 0.5%.

Timebase Accuracy and Linearity—5 μs/DIV and 10 μs/DIV Accuracy Over Center 10 Div ± 1%, Linearity Overall ± 1%.

Magnified Timing and Linearity—For center 10 divisions of unmagnified sweep: ± 2% accuracy, ± 2% linearity.

2 FIELD Sweep Length and Linearity—12.7 div, ± 0.5 div.

FIELD SELECTOR—Positive selection of ODD (2 & 4) or EVEN (1 & 3) in 525/60 Systems. Display starts on selected field. Positive selection of 1, 2, 3, or 4, or 1 & 3, 2 & 4, in 625/50 Systems. Display starts on selected field.

LINE SELECTOR—VARIABLE Range: From approximately line 20 of the selected field to approximately line 8 of the next complementary field (example, line 20 or field 1, to line 8 of field 3). Lines intensified by the strobe in 2 FIELD display are the lines displayed in 5 μs/DIV or 10 μs/DIV. DIGITAL: Selects line 9/322 to line 22/335. 15 LINE: Identical to VARIABLE, except that 15 successive lines are displayed. ALL FIELDS: Time overlay of all fields any setting of the DISPLAY switch.

Sync Input Requirements—INT 200 mV peak-to-peak to 2 V peak-to-peak composite video. EXT 400 mV peak-to-peak to 2 V peak-to-peak composite video, 200 mV peak-to-peak to 8 V peak-to-peak composite sync. Return loss ≥ 46 dB down to 5 MHz.

Maximum Jitter with 1 V Peak-to-Peak Composite Video + (−26) dB White Noise—Direct 250 ns, AFC 90 ns .

Maximum Jitter with Missing Horizontal Sync Pulses—≤ 15 ns/missing sync pulse (maximum of 10 consecutive horizontal sync pulses missing).

50 Hz/60 Hz Recognition—Automatically recognizes 50 Hz or 60 Hz scan in dual standard instrument.

Horizontal Trigger—AFC: Horiz. Frequency 15.750 ± 200 Hz, Lock-In Time ≤ 1 sec. Maximum Jitter with Respect to Input Sync 10 ns—Input composite Video or Composite Sync from a 140-series Generator, 12 ns-Variable APL, 12 ns—Variable APL & 4 V rms Hum, 30 ns—Variable APL & 4 V rms Hum + (−36) dB White Noise. Jitter Reduction with Respect to White Noise ≥ 8 dB.

DIRECT—Horiz. Frequency Range ≤ 20 kHz. Maximum Jitter with Respect to Input Sync 12 ns—input Composite Video or Composite Sync from a 140-series Generator, 20 ns—Variable APL, 20 ns—Variable APL & 4 V rms Hum, 90 ns —Variable APL & 4 V Tum ± (−36) dB White Noise.

EXTERNAL HORIZ IN — Sensitivity 0.5 V/div, Linearity ± 1%.

RGB/YRGB J9036—RGB Sweep Length Internally selected for ⅓ normal sweep. YRGB Sweep Length internally selected for ¼ normal sweep.

WAVEFORM COMPARISON—LOCATE: Range sufficient to place LOCATE indication any place on 5 μs/DIV, or unmagnified 10 μs/DIV sweeps. OVERLAY: Range sufficient to overlay any selected portion of 5 μs/DIV or unmagnified 10 μs/DIV on any other portion.

LINE STROBE OUT—Strobe output of line or lines selected by VARIABLE, 15 LINE, or DIGITAL line selector modes and the DISPLAY switch. TTL-amplitude, ac-coupled. Time Constant = 1 μF, 10 kΩ.

OPTION 1

10X Probe Channel—Scale Factor adjustable to 1 V peak-to-peak equivalent display height, GAIN Range ± 10%. Gain to AUX VIDEO: Unity, ± 3%, with gain adjusted for 1 V peak-to-peak equivalent display height. Tilt ≤ 5% on 50 Hz square wave, High Frequency Response ± 1%, 25 Hz to 5 MHz. ± 3%, 5 MHz to 10 MHz. Referenced to 50 kHz. Differential Phase < 0.25 at any APL. Differential Gain ≤ 0.25% at any APL. Input Resistance 1 MΩ, ± 2%, not including probe. Input RC Product 20 μs, ± 0.5%, not including probe. BNC connector accepts most TEKTRONIX probes. P6065A probe recommended.

10X Probe Calibrator—Output Voltage 1.000 V ± 0.005 V or 0.995 to 1.005 V.

OPTION 4

TAPE T.W. SYNC Input—NTSC: Syncs to either a standard negative-going composite sync pulse of 3.5 V to 4.5 V in amplitude, or a 240 Hz negative-going tape recorder pulse, 1.5 V to 4.5 V in amplitude, 2.083 ms in width, and 4.166 ms in period. PAL: Syncs to negative-going 200 Hz tape recorder pulse, 1.5 to 4.5 V in amplitude 2.5 ms in width, and 5 ms in period.

Mains Voltage—Ranges: 100 VAC, 110 VAC, 120 VAC, 200 VAC, 220 VAC, 240 VAC ± 10%. Frequency: 48 Hz to 62 Hz, Max Power Consumption 75 W.

OPERATING TEMPERATURE—0°C to 50°C.

Dimensions and Weights

1480 C Series		
Height	8.25 in	21 cm
Width	8.50 in	21.6 cm
Depth	16.95 in	43.0 cm
Net Weight	21.5 lb	9.81 kg
Domestic shipping weight	≈28.5 lb	≈12.9 kg
Export-packed weight	≈41.5 lb	≈18.8 kg

Two 1480 C Series Waveform Monitors can be mounted side-by-side, or one mounted alongside an associated picture monitor in a standard 19-inch rack or console.

1480 R Series		
Height	5.25 in	13.3 cm
Width	19.0 in	48.2 cm
Rack Depth	18.0 in	45.7 cm
Net Weight	24.6 lb	11.2 kg
Domestic shipping weight	≈53.1 lb	≈24.1 kg
Export-packed weight	≈75.1 lb	≈34.1 kg

Instrument fits standard 19-inch rack.

ORDERING INFORMATION

1480C NTSC Waveform Monitor
1480R NTSC Waveform Monitor
1481C PAL Waveform Monitor
1481R PAL Waveform Monitor
1482C PAL M Waveform Monitor
1482R PAL M Waveform Monitor
1485C PAL/NTSC Dual Standard Waveform Monitor
1485R PAL/NTSC Dual Standard Waveform Monitor

Option 01	1 megohm, 20 pf probe input (probe not included) Suggested Probe P6065A 10X Probe, 6-ft, Order 010-6065-13 9-ft, Order 010-6105-05
Option 02	With carrying Case (Cabinet Version Only)
Option 03	With Blank CRT
Option 07	Slow Sweep
Option 08	Adds capability of recognizing four field sequence of SECAM (1481C, 1481R, 1485C, 1485R only)

TEKTRONIX Automatic Correction Products are also available for 525/60 NTSC systems.

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TEKTRONIX®

Enhanced Video Measurement Capability Using the 15 Line Display of the TEKTRONIX 1480 Series Waveform Monitors

television application note no.15

As the television industry has come of age the viewing public, along with the technicians and engineers of the industry, has become an extremely critical judge of picture quality. This critical judgement forces the broadcaster to adopt ever more sophisticated measurement techniques, requiring greater accuracy in test methods and test equipment. For years the same general video measurement techniques, or difficult special tests, have been used on video tape recorders. This would be fine if only machine characteristics, such as frequency response, transient response or signal non-linearity were involved. However, many of the important performance characteristics of modern VTR systems are related to the individual heads, their equalizers and preamplifiers, rather than to overall VTR performance. This application note deals primarily with assessing the performance of individual heads, but does not ignore such VTR machine problems as time base instability, jitter, distorted or missing sync pulses, or field time distortion.

In order to accurately evaluate VTR head performance of modern quadruplex machines, a novel waveform monitor display mode had to be adopted. The TEKTRONIX 1480-Series Waveform Monitors incorporate this new 15-line display mode. While its primary application is to VTR head evaluation, other applications where selected groups of lines must be looked at provides this mode with extra versatility. This display mode selects 15 adjacent lines and displays them one on top of the other as shown in Figure 1. Using the 15-line display mode provides a much brighter display than a line selected one (1H) or two (2H) line display, but still does not confuse the operator with extraneous information, as would happen in a full field display.

The following paragraphs will show how to use the 1480-Series Waveform Monitor 15-line display mode to evaluate each individual head of a quadruplex VTR for signal-to-noise ratio and non-linear distortion (differential gain and differential phase). In addition to the 1480-Series Waveform Monitor a noise measurement system, such as the TEKTRONIX 1430, or the 147/147A (NTSC), 148 (PAL) or 148-M(PAL-M), and a Vectorscope 520/520A (NTSC), 521/521A (PAL) or 522/522A(PAL-M) are required.

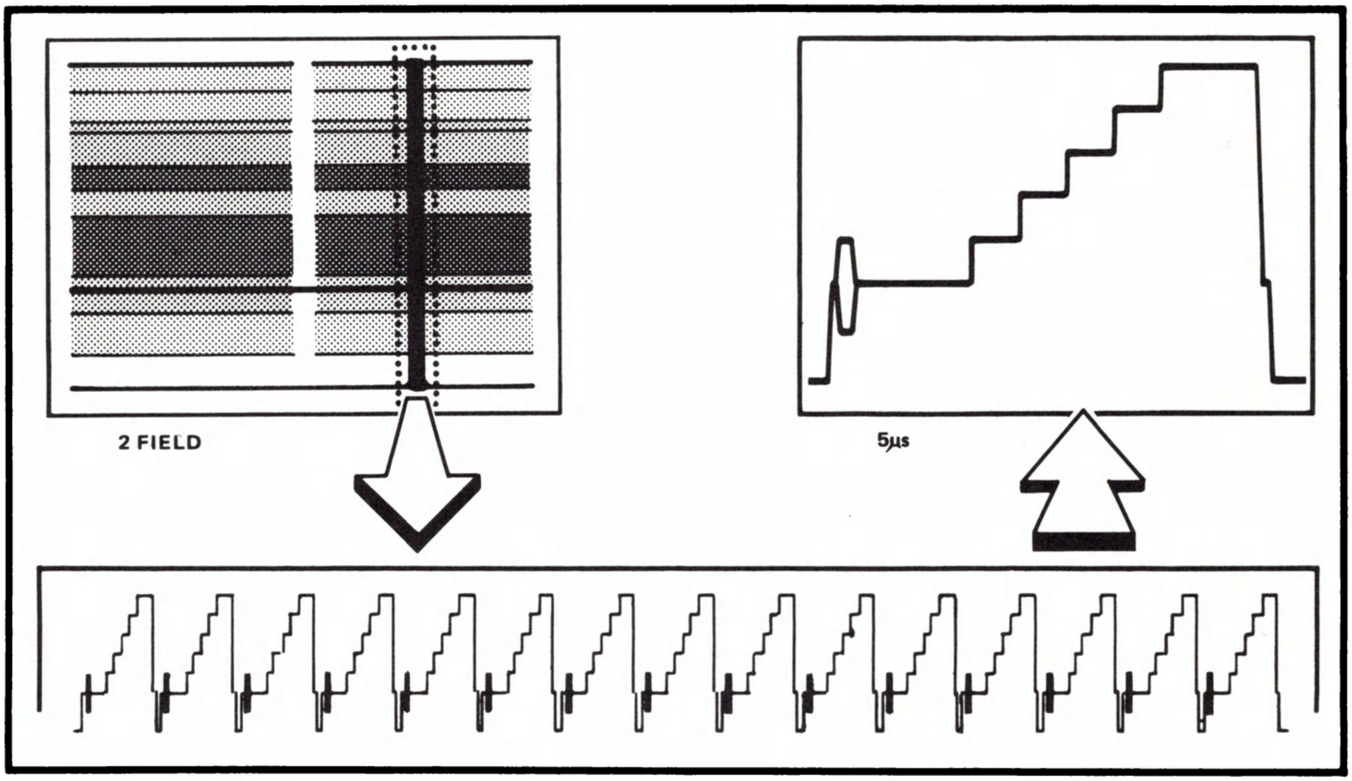

Figure 1. *15 line display mode. Any 15 lines may be selected and displayed overlaid.*

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The Monitor and the VTR

Figure 2 shows the interconnections for routine operation and maintenance of a broadcast videotape recorder. The video signal is provided to the Waveform Monitor from a signal selector panel in the VTR. The Waveform Monitor displays this signal, and also provides a unique video signal to a picture monitor. In any of the line selector modes, digital, variable, or 15-line, the lines being displayed on the Waveform Monitor appear intensified on the picture monitor. In the 2 field mode of the Waveform Monitor, these selected lines are displayed as an intensified portion of the sweep, as shown in Figure 3. This is an excellent way to exactly locate the lines of interest within a picture. Select the desired mode and simply adjust the VARIABLE LINE SELECTOR control until the lines of interest are intensified, and those will be the lines displayed when the time base is changed to give a one or two-line display. The picture monitor always shows those intensified lines being displayed on the Waveform Monitor independent of the horizontal sweep mode of the Waveform Monitor.

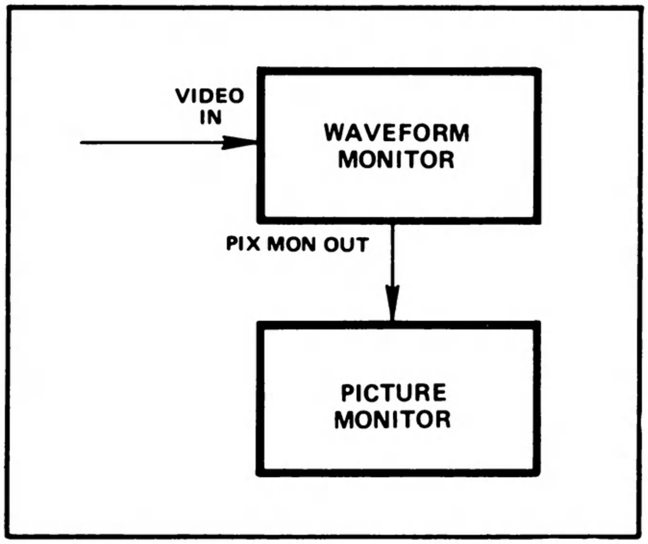


Figure 2. *Equipment setup for normal VTR operation and maintenance.*

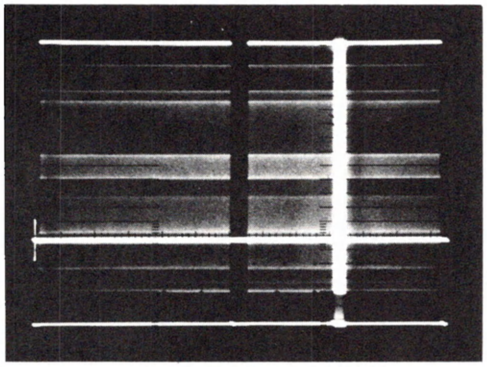


Figure 3. *Two field display with selected lines intensified.*

In a quadruplex videotape recorder, each head pass covers just a bit more than 15 lines, so by correctly placing the 15-line display the Waveform Monitor can show each head individually or it can show the transition between any two consecutive heads. Head identification (and correct placement of the intensified portion) may at first seem difficult, but is actually quite easily done. By slightly misadjusting the VTR's female tape guide and viewing the signal before any time base correction is applied, the characteristic scalloping of the picture seen on the picture monitor indicates the area scanned by each head.

Figure 4 shows the picture monitor display used to locate each head. When the VTR is operating in the home track mode the first sixteen lines of the field, starting with the serrated vertical pulse, are covered by head number 4. The first lines shown in figure 4 are from head number 2, making the sequence of head passes 4, 2, 3, 1, 4, etc. The brightened portion in figure 4 indicates that we are looking at head number 1. After the head has been located in this manner, the female tape guide is returned to its correct position and the desired test or adjustment is made.

If it is desired to compare the characteristics of two adjacent heads, the brightened portion of the picture is positioned to straddle the two heads, and the Waveform Monitor then displays the output of these heads overlaid one on another for easy comparison. Figure 5 shows two heads of a quadruplex videotape machine overlaid to show differential chroma gain between them.

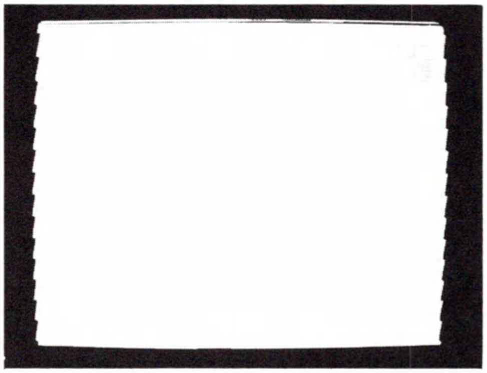


Figure 4. *Picture monitor display showing selected 15 lines. Notice how easily each head of the VTR can be identified.*

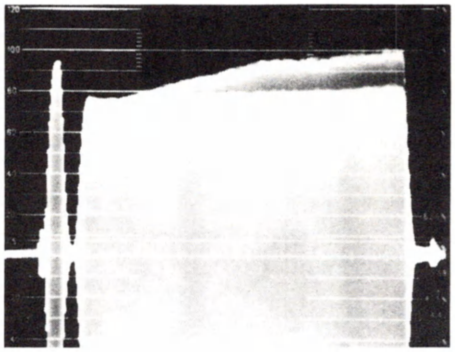


Figure 5. *Difference in differential gain between two adjacent video heads as observed on a 1480-Series Waveform Monitor.*

Head Signal-to-Noise Ratio Measurements

Video signal-to-noise ratio of each individual head can be measured using the 1480-Series Waveform Monitor 15-line display mode in conjunction with the Tektronix developed noise measurement by comparison technique. A TEKTRONIX 147/147A NTSC Test Signal Generator or 148/148-M Insertion Test Signal Generator (PAL) or (PAL-M), which include the noise measurement feature, or the TEKTRONIX 1430 Random Noise Measuring Set can be used. In the case of the 147/

147A, 148, or 148-M, external low pass filters should be employed between the generator and the 1480-Series Waveform Monitor. Use a 4.2 MHz low pass filter with the 147/147A or 148-M and a 5 MHz low pass filter with the 148. The 1430 contains its own filter and does not require the use of external filters.

Figure 6 shows the equipment connections for signal-to-noise measurements on a head-by-head basis. A length of tape is recorded with a flat field signal and played back. The TEKTRONIX 1430, 147/147A, 148 or 148-M provides the calibrated noise insertion for comparison with the VTR head noise. The video head of interest in selected by observing the picture monitor. The noise generator is then adjusted to match the head noise.

The 15-line display mode allows excellent accuracy for this comparison by giving a bright "stacked" display of all 15 lines, rather than trying to evaluate one line as was previously done. This improved resolution provides greater accuracy as well as the increase in brightness.

It is not necessary to correctly adjust the female tape guide before making the head signal-to-noise measurement because accurate guide positioning is not necessary to this measurement. Each head can be checked and the results compared.

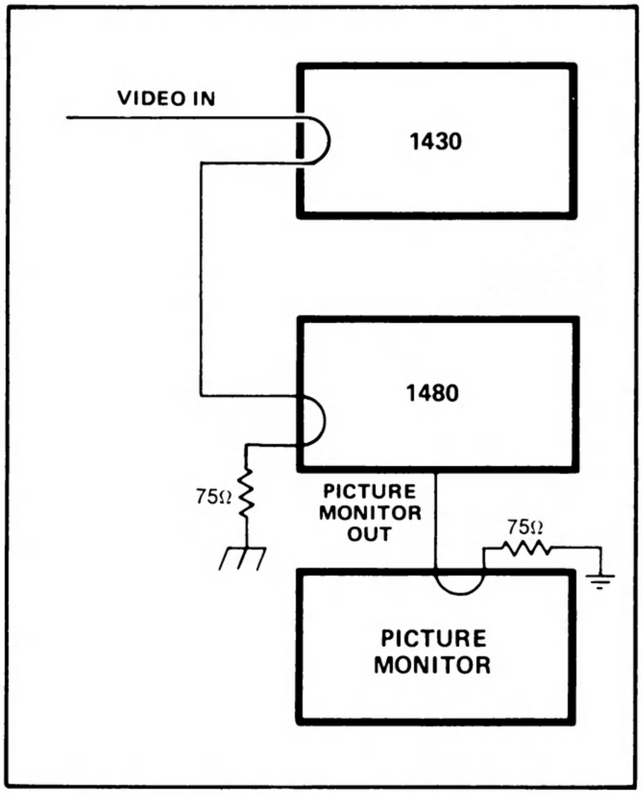

VIDEO IN
1430
1480
75Ω
PICTURE MONITOR OUT
75Ω
PICTURE MONITOR

Figure 6. *Equipment connections for head-by-head noise measurement.*

Radical differences in signal-to-noise ratio between heads may indicate that the headwheel has reached the end of its useful life.

This is especially true in production houses where the same machine is used for playback in productions requiring multiple generations. Each generation will be more noisy than the former, and the end result may have unacceptable noise banding from just one noisy head. This measuring technique will determine whether the head should be replaced before expensive studio production time is wasted. Figures 7 through 10 show the results of this noise measuring technique on the headwheel of a typical VTR using a TEKTRONIX 1430 Noise Measuring Set.

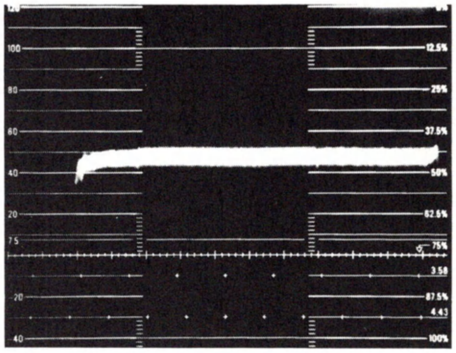

100
80
60
40
20
7.5
-20
-40
12.5%
25%
37.5%
50%
62.5%
75%
3.58
87.5%
4.43
100%

Figure 7. *Head #1 noise measurement —50 dB noise.*

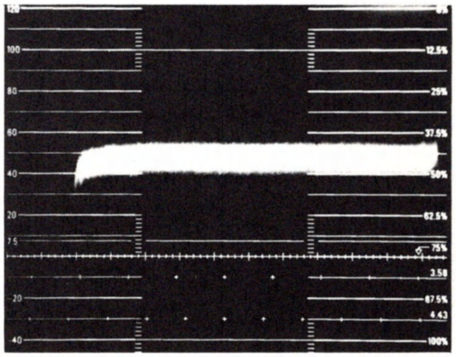

100
80
60
40
20
7.5
-20
-40
12.5%
25%
37.5%
50%
62.5%
75%
3.58
87.5%
4.43
100%

Figure 8. *Head #2 noise measurement —44 dB noise.*

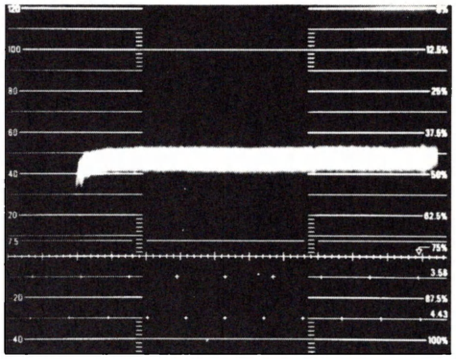

100
80
60
40
20
7.5
-20
-40
12.5%
25%
37.5%
50%
62.5%
75%
3.58
87.5%
4.43
100%

Figure 9. *Head #3 noise measurement —45 dB noise.*

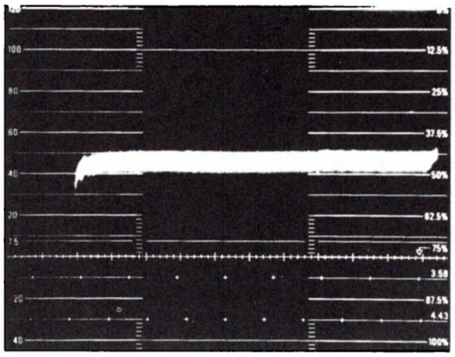

100
80
60
40
20
7.5
20
40
12.5%
25%
37.5%
50%
62.5%
75%
3.58
87.5%
4.43
100%

Figure 10. *Head #4 noise measurement —51 dB noise.*

VTR Differential Phase and Gain Measurements

Measuring differential gain and differential phase on a quadruplex VTR has always been rather difficult because the vectorscope display of the distortion appears to be very noisy. Figure 11 shows a typical full field display of a videotape machine playback signal. Actually, the display appears noisy because each individual head has slightly different differential gain and phase characteristics which are overlaid one on another in the full field measurement mode. Each head and its associated amplifier and equalizer contribute their individual characteristics to the full field display. By properly adjusting the equalization on a head-by-head basis so that the individual head characteristics are essentially the same, optimum performance may be realized, and the objectionable effect of head to head differences in response will be eliminated or reduced. Differential gain and phase measurements of a videotape recorder on a head-by-head basis can be made using a 1480-Series Waveform Monitor and a TEKTRONIX 520-Series Vectorscope.

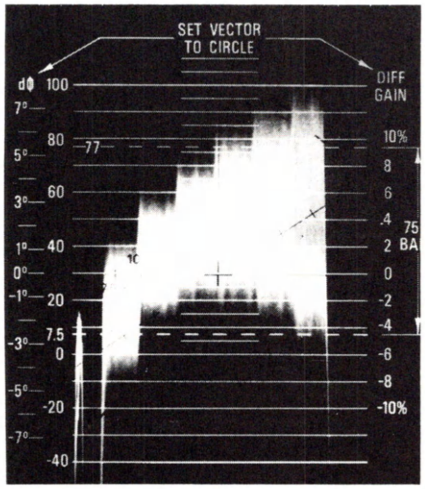


Figure 11. *Full field differential phase of quadruplex VTR. A confusing display for accurate measurements.*

Slight alteration of the 520-Series Vectorscope is required to use the 1480-Series Waveform Monitor strobe output to unblank the lines of interest. In addition, a pair of signal diodes will need to be added to the PAL or PAL-M 520-Series Vectorscope to retain PAL blanking.

To modify the Vectorscope (except 520s below serial number B15000) for unblanking by the strobe output of the 1480-Series Waveform Monitor, move the coax cable from pin BO of the sweep circuit board to pin BQ. (For 520s below serial number B15000 only; move the coax cable from pin AR of the sweep circuit board to pin AW). Install the signal diodes in either 521/521A or 522/522A Vectorscopes as follows; Place one, anode to coax cable, between pin BR of the sweep circuit board and the coax cable connected to it. The second, again anode to coax cable, between pin BQ and the coax cable that has been moved to it. If +V, −V identification is not needed, disconnect the coax cable from pin BR and skip installing the diodes.

Figure 12 shows the equipment hook-up for differential gain and phase measurements.

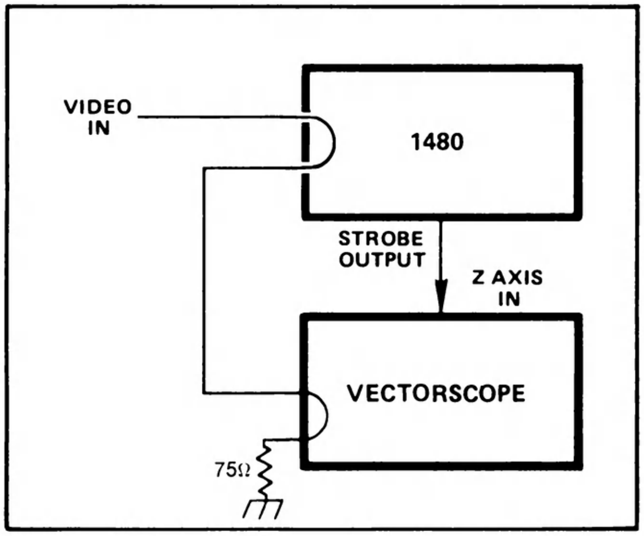


Figure 12. *Equipment connections for differential gain and phase measurements.*

For this measurement, record several minutes of modulated stairstep or ramp on the recorder, and rewind. On playback, locate the head of interest as previously described, set up the vectorscope for the desired measurement, place the VTR female guide in its proper position, and make the measurement on the vectorscope. Only the lines selected by the Waveform Monitor will appear on the vectorscope screen, so each head and its associated amplifier can be checked individually for differential gain and phase. Figures 13 through 16 show the differential phase and gain characteristics of a quadruplex VTR. Notice how much more easily the necessary adjustments can be made by reference to these displays compared to attempting to do the same thing with a display like Figure 11.

Differential gain and phase on a VTR are primarily functions of equalization so it is possible to optimize the playback equalization of each head for minimum distortion by adjusting the equalization while observing the vectorscope. By looking at only one head at a time the operator can easily and quickly minimize these distortions.

Figure 13. *Differential Gain*

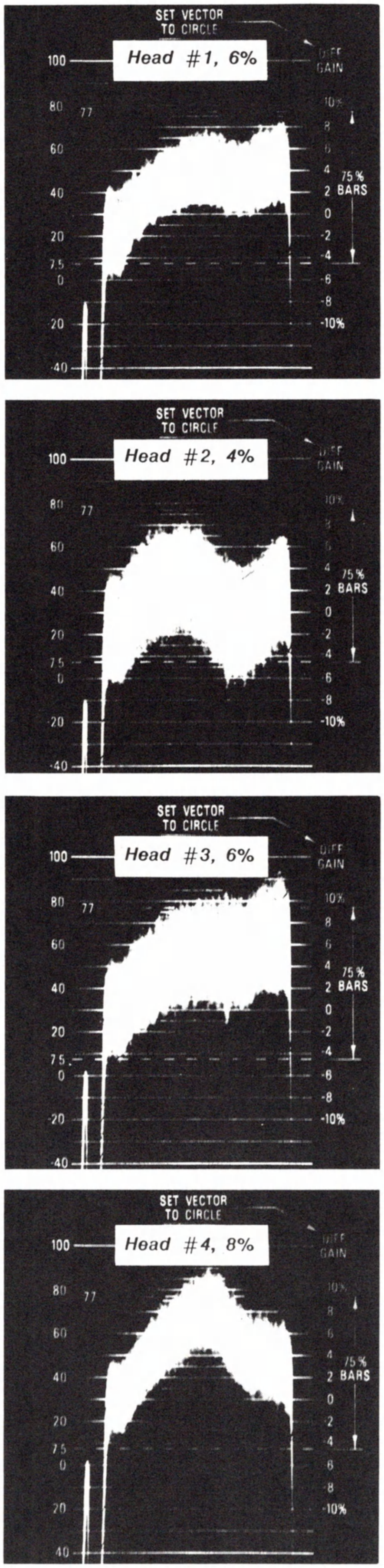
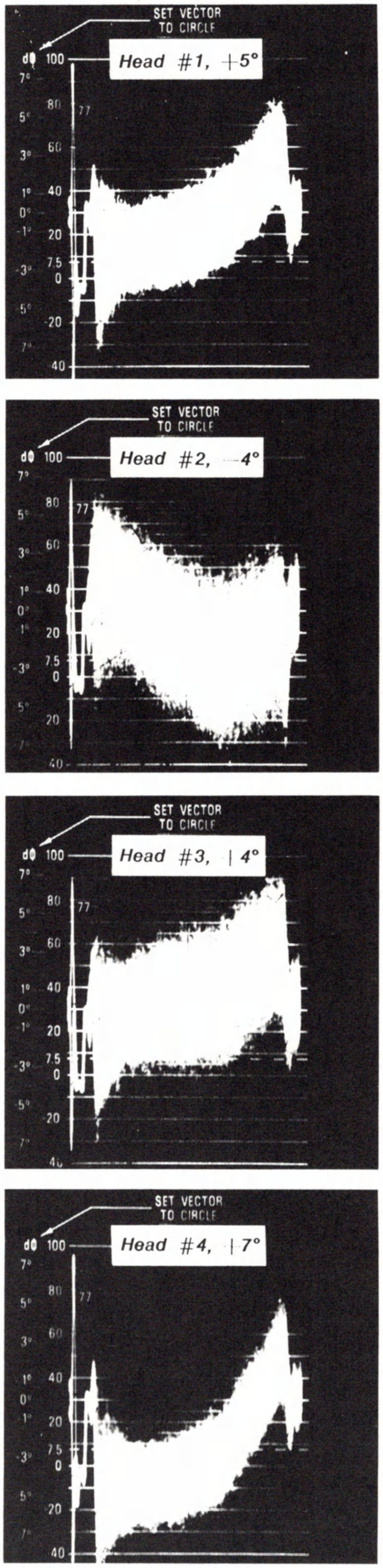


Figure 14. *Differential Phase*



Checking Time Base Stability

The 1480 includes automatic frequency control of the time base so jitter can be measured. Heretofore this has not been possible on a Waveform Monitor. A 1480-Series Waveform Monitor operating in the 15-line mode gives a display of very nearly one millisecond of picture signal in either a 525/60 or 625/50 system. This is a convenient time frame in which to make time base jitter measurements. Select the 15-line, 10 μsec/div display, set the sync selector to internal, AFC on and magnify the display to observe the leading edge of sync. Any time base instability will be readily apparent. This measurement is particularly useful in applications where a mechanical scanner is used to reproduce video, such as a quadruplex or helical scan videotape recorder. By "windowing" down through the field, mechanical problems causing instability will be readily apparent. Figure 15 shows jitter in the playback signal of a helical scan VTR caused by a dirty head drum bearing.

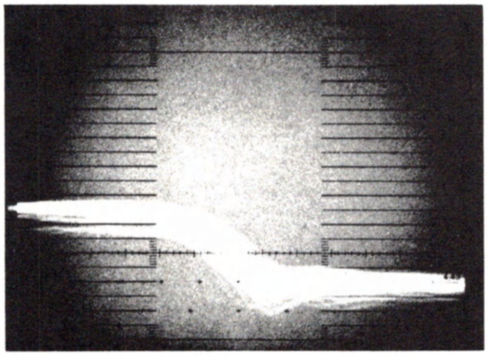


Figure 15. *Time base jitter of a helical scan VTR. The one millisecond time frame of the 15-line display is convenient for this type of measurement.*

Transmitter Measurements

The 1480-Series of Waveform Monitors provides the capability for all the usual transmitter measurements made with a Waveform Monitor, and the unique Z-axis signal gating provided to a vectorscope allows some unusual distortions sometimes found in television visual transmitters to be observed. One of the most apparent of these distortions is field rate phase modulation of chrominance. This distortion appears as a hue shift for the first few lines of picture, usually after vertical blanking. Figure 16 shows the demodulated output of a television transmitter with about 3° of chrominance phase modulation.

The 15-line display mode of the TEKTRONIX 1480-Series of Waveform Monitors is a valuable tool for many unique video measurements, providing previously unavailable capabilities for measurement in videotape recorders, transmitters and other areas of television operations. The ability to analyze the characteristics of each head of a videotape recorder provides an excellent means for optimizing record/reproduce performance. The individual head noise measurement technique can save costly production time by indicating the need for head replacement well in advance of noise banding in multiple generations. Field rate related distortions are also readily apparent using the expanded measurement capabilities of the TEKTRONIX 1480-Series of Television Waveform Monitors.

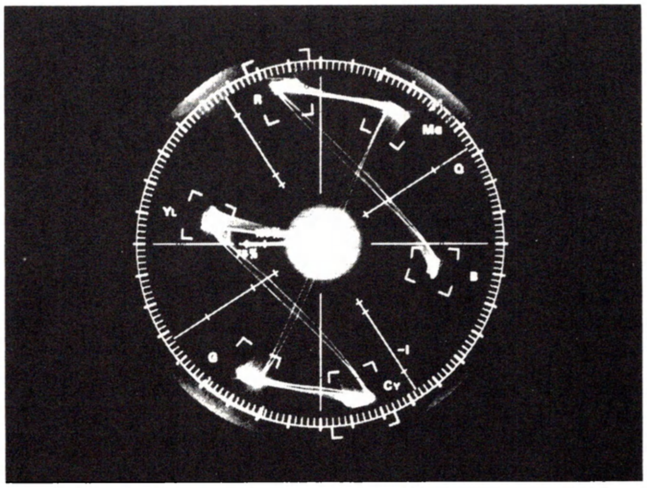


Figure 16. *Field time chrominance phase modulation of a visual transmitter.*

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6/75 AX-3077-I

application notes

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no. 16

Verifying the Bruch Blanking Sequence

Verification of the Bruch blanking sequence falls into the area of routine testing and, though necessary, is tedious. Using the accurate four-field selection of a 1480-Series Waveform Monitor can reduce the time required for this test. In essence, only 4 lines need to be observed to accurately determine if the sequence is occurring correctly on each field. Figure 1 shows the PAL Bruch blanking sequence and identifies lines 6, 310, 319 and 623. If the Bruch blanking sequence for PAL-M (525/60 used in Brazil) is being verified, using a PAL-M 1480-Series Waveform Monitor, disregard Figure 1. Lines 8, 259, 270, and 522 will be substituted for those above. Table 1, in the Verification Procedure, is prepared for both 625/50 PAL and 525/60 PAL-M.

The Verification Procedure that follows displays portions of two fields. The first field whose sync triggers the time base, corresponds to the field selected by front panel pushbutton. The investigation of the blanking sequence takes place at the end of this field and the beginning of the next field. Figure 2 shows field 4 followed by field 1 (FIELD 4 selected).

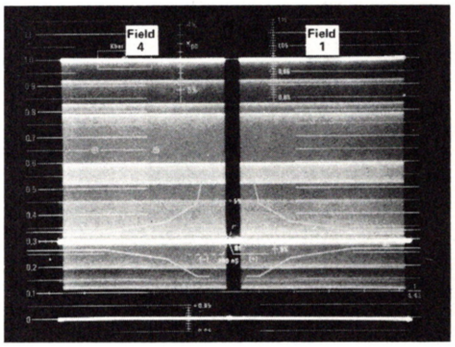

Figure 2.

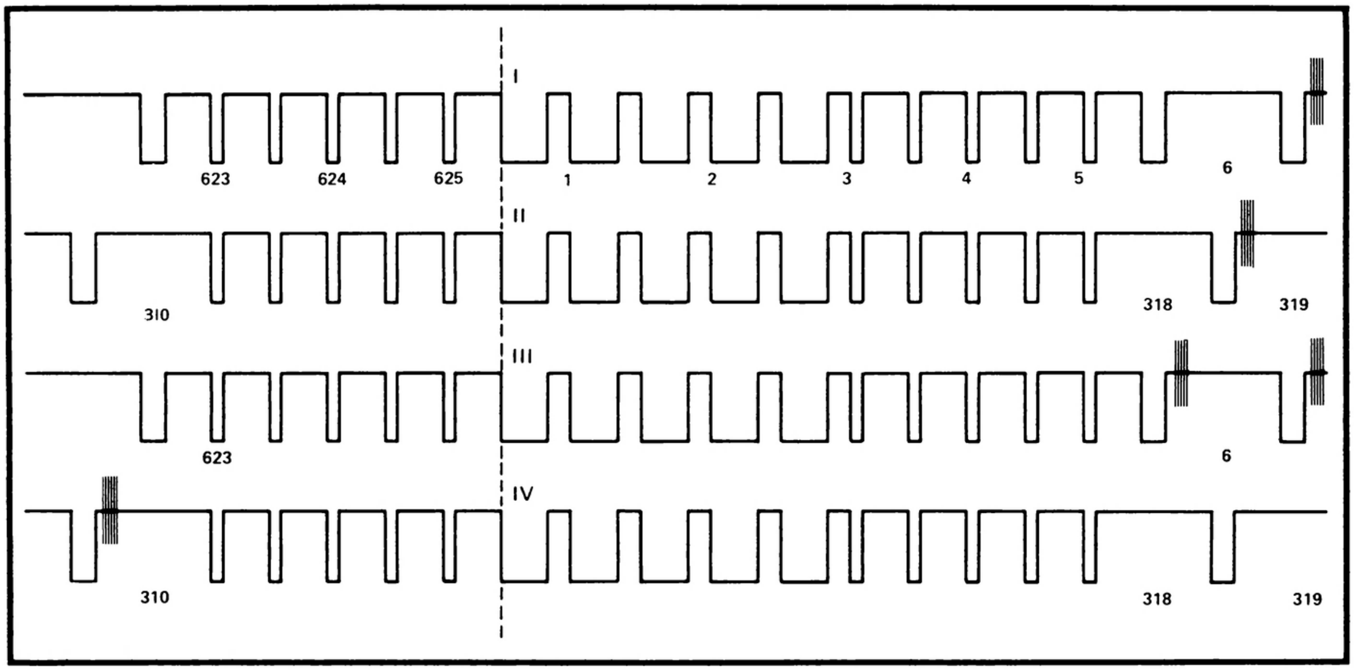

Figure 1.

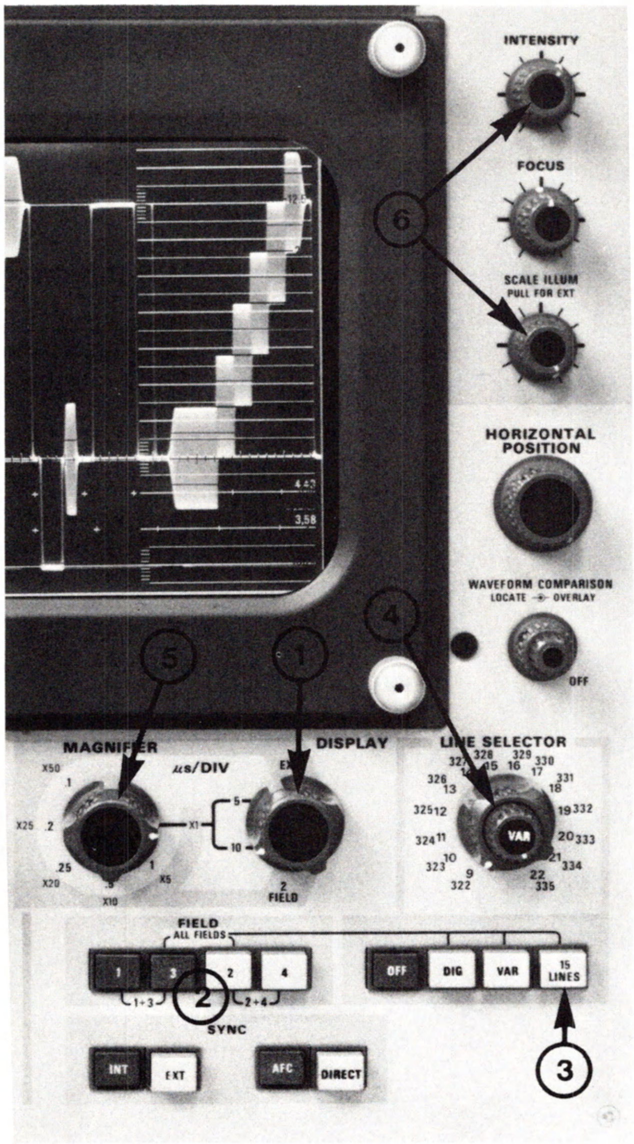
INTENSITY
FOCUS
SCALE ILLUM
PULL FOR EXT
HORIZONTAL POSITION
WAVEFORM COMPARISON
LOCATE OVERLAY
OFF
MAGNIFIER
µs/DIV
DISPLAY
LINE SELECTOR
VAR
FIELD
ALL FIELDS
1
3
2
4
1+3
2+4
OFF
DIG
VAR
15 LINES
SYNC
INT
EXT
AFC
DIRECT
1
2
3
4
5
6

Figure 3.

Figure 3 shows the location of the switches and controls used in the following procedure. The numbers associated with the controls correspond to the step in the procedure in which that control is used.

Verification Procedure

1. Set the DISPLAY switch to 2 FIELD.
2. Depress FIELD 1 and 3 pushbuttons simultaneously.
3. Depress 15 LINES.
4. Adjust VAR LINE SELECTOR to place the intensified portion of the display on the interval between the two fields.
5. Turn the MAG switch to X50.
6. Adjust the HORIZONTAL POSITION to place the interval at mid-screen. Reduce the INTENSITY until the brightened interval is obvious. Readjust the VAR LINE SELECTOR as necessary to display the interval and at least 2 lines on either side of the interval.
7. Check for a burst on either side of the interval with a discernable flicker rate (caused by a reduced repetition rate) indicating the presence of the blanking sequence. Even if the sequence appears to be in error proceed to Step 8, where each field is investigated individually, so that the fault can be located.
8. Depress the FIELD 4 pushbutton. Check the display against that in Figure 4 and use Table 1 to determine if burst is occurring on the correct lines. Follow the remainder of Table 1 using Figure 5 as a reference to check out the entire Bruch blanking sequence.

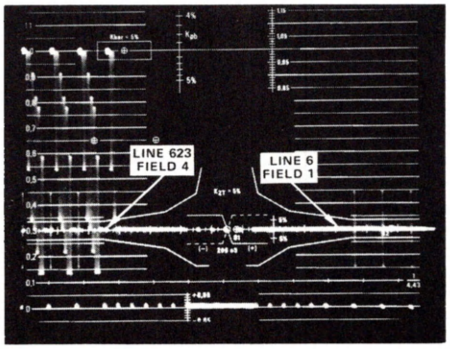
LINE 623
FIELD 4
LINE 6
FIELD 1

Figure 4.

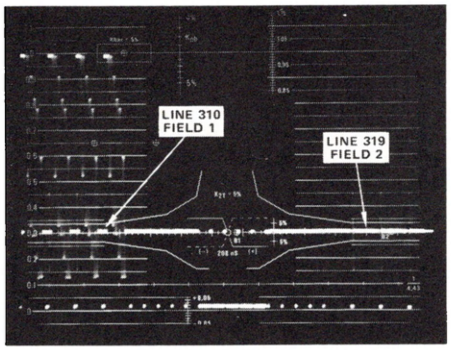

Figure 5a.

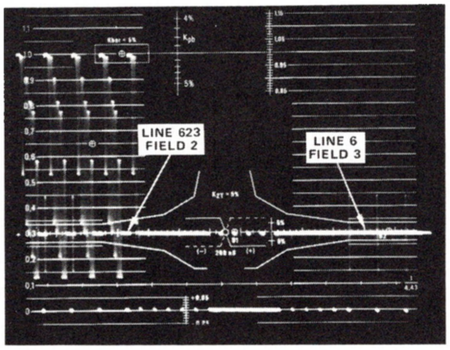

Figure 5b.

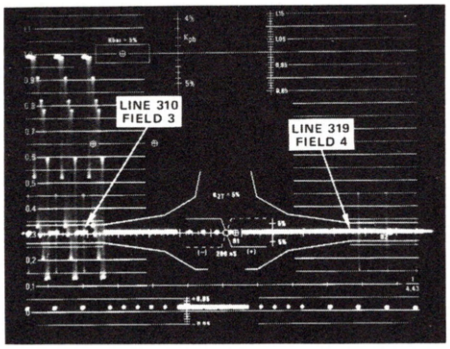

Figure 5c.

The switching used to check the Bruch blanking sequence can also be used to check burst phasing. A minor operational change to a TEKTRONIX 520-Series Vectorscope (521-521A for 625/50 PAL or 522-522A for 525/60 PAL-M) provides an accurately phased display of the burst on selected line for a particular field. Shift the lead that is on pin BO of the Sweep Circuit Board to pin BQ and lift the lead from pin BR. Connect the 1480-Series Waveform Monitor LINE STROBE OUT to the Vectorscope Z-AXIS INPUT and loop-thru connect the video signal to one of the Vectorscope signal inputs. Set the Vectorscope display to FULL FIELD. Set the 1480-Series Waveform Monitor's LINE SELECTOR to 17/330 and depress the DIG pushbutton. The Vectorscope is now displaying the phase of the burst for the selected lines as switched by the 1480-Series Waveform Monitor's FIELD selection pushbuttons. Burst phase is as follows: Field 1 — 135 . Field 2 — 225 , Field 3 — 225 and Field 4 — 135 .

This Application Note has taken advantage of two of the 1480-Series Waveform Monitor's display features, accurate field selection and the 15-line display (used to intensify the displayed vertical intervals). In addition the LINE STROBE OUT was used, along with the field switching, to control the display on a Vectorscope for a quick look at burst phasing.

Table 1

Field Selector	Field	Line Number		Burst	
		PAL	(PAL-M)	PAL	(PAL-M)
4	4	623	(522)	No	(Yes)
	1	6	(8)	No	(No)
1	1	310	(259)	No	(Yes)
	2	319	(270)	Yes	(No)
2	2	623*	(522)	No	(No)
	3	6	(8)	Yes	(Yes)
3	3	310	(259)	Yes	(No)
	4	319	(270)	No	(Yes)

*No burst on either line 622 or line 623 of field 2.

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5-77 AX-3078-1

SCALE FACTOR—INPUT A and B 1.0 Volts Full Screen 1 ± 3 mV, 0.5 Volts Full Screen ± 15 mV, 0.2 V/F Screen ± 6 mV.

Ratio: INPUT A to INPUT B 1, ± 0.002, to 1. AUX VIDEO IN to INPUT A 1.5 ± 0.3 dB.

GAIN—INPUT A to AUX VIDEO OUT 1, ± 0.005, INPUT A to PIX MONITOR OUT 1, ± 0.02.

VARIABLE VOLTS FULL SCALE RANGE—Input signals between 0.7 volts and 2.0 volts can be adjusted to 1 volt equivalent display height.

Maximum Input Signal—for inspecification operation of AUX VIDEO OUT and PIX OUT. AC CPL'D: INPUT A and B 2.0 V P-P at any APL—Display distortion. 1.0 V P-P at any APL if both AUX VIDEO OUT and PIX OUT are terminated for distortion-free signal at those outputs.
DC CPL'D: INPUT A and B ± 1.5 V, DC ± Peak AC, AUX VIDEO IN ± 1.5 V, DC ± Peak AC.

Maximum Output DC Voltage, AUX VIDEO OUT and PIX MONITOR OUT into 75 Ω—± 0.5 V DC.
Common Mode Rejection Ratio (A-B)—60 Hz ≥ 46 dB, 15 kHz ≥ 46 dB, 4.43 MHz ≥ 34 dB.

Frequency Response—FLAT including: INPUT A or INPUT B Through AUX VIDEO OUT or PIX MONITOR OUT from 50 kHz Reference: 50 kHz to 5 MHz ± 0.5%, 5 MHz to 10 MHz + 0.5%, −3%. IRE: Conforms to IRE 1958 standard 23S-1. Attenuation at 4.43 MHz, ≥ 22 dB. LOW PASS: Attenuation ≥ 14 dB, 500 kHz and above. 3.58 MHz ± 1% of FLAT at 3.58 MHz, 3 dB down at 3.1 to 3.4 MHz and 3.8 to 4.0 MHz. 4.43 MHz ± 1% of FLAT at 4.43 MHz, 3 dB down at 3.9 to 4.1 MHz and 4.7 to 4.9 MHz. DIFF'D STEPS: Permits amplitude comparisons of risers on stairstep signal with automatic gain increase of 5 times, attenuation < 2 dB from 0.4 to 0.5 MHz, attenuation ≥ 20 dB at 15 kHz and 2 MHz, attenuation ≥ 40 dB at 3.58 MHz and 4.43 MHz.

Linear Waveform Distortion — Pulse Preshoot, Pulse Overshoot, and Pulse Ringing < 0.5% of applied pulse amplitude. 25 μs Bar Tilt < 0.5%. Field Square Wave Tilt < 1%, Pulse to Bar Ratio 0.99:1 to 1.01:1 or 0.99 to 1.01:1.

Non-Linear Waveform Distortion — Differential Gain Displayed < 0.5% at any APL, AUX VIDEO OUT and PIX MONITOR OUT < 0.25% at any APL. Differential Phase—AUX VIDEO OUT and PIX MONITOR OUT < 0.25 at any APL.

DC RESTORER—Mains Hum Attenuation, Slow < 10%. Fast ≥ 26 dB. Shift caused by Presence or Absence of Burst < 1 IRE or 7 mV.

Return Loss (With 75 Ω Termination)—INPUT A or B ≥ 40 dB, DC to 5 MHz. AUX VIDEO IN, AUX Video OUT, or PIX MONITOR OUT ≥ 34 dB, DC to 5 MHz.

Vertical Overscan—for 1 V Peak-to-Peak Composite Video Signal all specifications are valid at 1.0, 0.5, and 0.2 volts FULL SCALE, and any vertical position setting to 5 MHz.

Calibrator Accuracy—1 V ± 0.2%, 714 mV and 700 mV ± 0.5%.

Timebase Accuracy and Linearity—5 μs/DIV and 10 μs/DIV Accuracy Over Center 10 Div ± 1%. Linearity Overall ± 1%.

Magnified Timing and Linearity—For center 10 divisions of unmagnified sweep: ± 2% accuracy, ± 2% linearity.

2 FIELD Sweep Length and Linearity—12.7 div, ± 0.5 div.

FIELD SELECTOR—Positive selection of ODD (2 & 4) or EVEN (1 & 3) in 525/60 Systems. Display starts on selected field. Positive selection of 1, 2, 3, or 4, or 1 & 3, 2 & 4, in 625/50 Systems Display starts on selected field.

LINE SELECTOR—VARIABLE Range: From approximately line 20 of the selected field to approximately line 8 of the next complementary field (example, line 20 or field 1, to line 8 of field 3). Lines intensified by the strobe in 2 FIELD display are the lines displayed in 5 μs/DIV or 10 μs/DIV. DIGITAL: Selects line 9/322 to line 22/335. 15 LINE: Identical to VARIABLE, except that 15 successive lines are displayed. ALL FIELDS: Time overlay of all fields any setting of the DISPLAY switch.

Sync Input Requirements—INT 200 mV peak-to-peak to 2 V peak-to-peak composite video. EXT 400 mV peak-to-peak to 2 V peak-to-peak composite video. 200 mV peak-to-peak to 8 V peak-to-peak composite sync. Return loss ≥ 46 dB down to 5 MHz.

Maximum Jitter with 1 V Peak-to-Peak Composite Video + (−26) dB White Noise—Direct 250 ns, AFC 90 ns .

Maximum Jitter with Missing Horizontal Sync Pulses—< 15 ns/missing sync pulse (maximum of 10 consecutive horizontal sync pulses missing).

50 Hz/60 Hz Recognition—Automatically recognizes 50 Hz or 60 Hz scan in dual standard instrument.

Horizontal Trigger—AFC: Horiz. Frequency 15.750 ± 200 Hz, Lock-In Time < 1 sec. Maximum Jitter with Respect to Input Sync 10 ns—Input composite Video or Composite Sync from a 140-series Generator, 12 ns-Variable APL, 12 ns—Variable APL & 4 V rms Hum, 30 ns—Variable APL & 4 V rms Hum + (−36) dB White Noise. Jitter Reduction with Respect to White Noise ≥ 8 dB.

DIRECT—Horiz. Frequency Range < 20 kHz. Maximum Jitter with Respect to Input Sync 12 ns—input Composite Video or Composite Sync from a 140-series Generator, 20 ns—Variable APL, 20 ns—Variable APL & 4 V rms Hum, 90 ns —Variable APL & 4 V Tum ± (−36) dB White Noise.

EXTERNAL HORIZ IN — Sensitivity 0.5 V/div, Linearity ± 1%.

RGB/YRGB J9036—RGB Sweep Length Internally selected for ⅓ normal sweep. YRGB Sweep Length internally selected for ¼ normal sweep.

WAVEFORM COMPARISON—LOCATE: Range sufficient to place LOCATE indication any place on 5 μs/DIV. or unmagnified 10 μs/DIV sweeps. OVERLAY: Range sufficient to overlay any selected portion of 5 μs/DIV or unmagnified 10 μs/DIV on any other portion.

LINE STROBE OUT—Strobe output of line or lines selected by VARIABLE, 15 LINE, or DIGITAL line selector modes and the DISPLAY switch. TTL-amplitude, ac-coupled. Time Constant 1 μF, 10 kΩ.

OPTION 1
10X Probe Channel—Scale Factor adjustable to 1 V peak-to-peak equivalent display height. GAIN Range ± 10%. Gain to AUX VIDEO: Unity, ± 3%, with gain adjusted for 1 V peak-to-peak equivalent display height. Tilt ≤ 5% on 50 Hz square wave, High Frequency Response ± 1%, 25 Hz to 5 MHz, ± 3%, 5 MHz to 10 MHz. Referenced to 50 kHz. Differential Phase ≤ 0.25 at any APL. Differential Gain ≤ 0.25% at any APL. Input Resistance 1 MΩ ± 2%, not including probe. Input RC Product 20 μs, ± 0.5%, not including probe. BNC connector accepts most TEKTRONIX probes. P6065A probe recommended

10X Probe Calibrator—Output Voltage 1.000 V ± 0.005 V or 0.995 to 1.005 V.

OPTION 4
TAPE T.W. SYNC Input—NTSC: Syncs to either a standard negative-going composite sync pulse of 3.5 V to 4.5 V in amplitude, or a 240 Hz negative-going tape recorder pulse, 1.5 V to 4.5 V in amplitude, 2.083 ms in width, and 4.166 ms in period. PAL: Syncs to negative-going 200 Hz tape recorder pulse, 1.5 to 4.5 V in amplitude 2.5 ms in width, and 5 ms in period.

Mains Voltage—Ranges: 100 VAC, 110 VAC, 120 VAC, 200 VAC, 220 VAC, 240 VAC ± 10%. Frequency: 48 Hz to 62 Hz, Max Power Consumption 75 W.

OPERATING TEMPERATURE—0 C to 50 C.

Dimensions and Weights

1480 C Series		
Height	8.25 in	21 cm
Width	8.50 in	21.6 cm
Depth	16.95 in	43.0 cm
Net Weight	21.5 lb	9.81 kg
Domestic shipping weight	≈28.5 lb	≈12.9 kg
Export-packed weight	≈41.5 lb	≈18.8 kg

Two 1480 C Series Waveform Monitors can be mounted side-by-side, or one mounted alongside an associated picture monitor in a standard 19-inch rack or console.

1480 R Series		
Height	5.25 in	13.3 cm
Width	19.0 in	48.2 cm
Rack Depth	18.0 in	45.7 cm
Net Weight	24.6 lb	11.2 kg
Domestic shipping weight	≈53.1 lb	≈24.1 kg
Export-packed weight	≈75.1 lb	≈34.1 kg

Instrument fits standard 19-inch rack.

ORDERING INFORMATION
1480C NTSC Waveform Monitor
1480R NTSC Waveform Monitor
1481C PAL Waveform Monitor
1481R PAL Waveform Monitor
1482C PAL M Waveform Monitor
1482R PAL M Waveform Monitor
1485C PAL/NTSC Dual Standard Waveform Monitor
1485R PAL/NTSC Dual Standard Waveform Monitor

Option 1 1 megohm, 20 pf probe input (probe not included)
  Suggested Probe
  P6065A 10X Probe, 6-ft. Order 010-6065-13
  9-ft. Order 010-6105-05
Option 2 With carrying Case (Cabinet Version Only)
Option 3 With Blank CRT

TEKTRONIX Automatic Correction Products are also available for 525/60 NTSC systems.

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application notes

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no. 17

The Auxiliary Video Facility of the 1480-Series of Waveform Monitors.

by L. E. Weaver
Tektronix European TV Engineering Consultant

The AUXILIARY VIDEO facility of the 1480-Series of Waveform Monitors is a novel and imaginative feature, whose inclusion indicates the care taken during the planning of these instruments to ensure the greatest flexibility of use, combined with ease of operation and a degree of protection against obsolescence.

Its primary function is to make possible a wide range of signal processing facilities in a side chain, which can be switched in or out without impairing the normal use of the instrument. As can be seen from the schematic diagram (Figure 1), the AUX VIDEO path is functionally an alternative to the built-in range of networks available by the use of the RESPONSE control, but with the advantage of being isolated from the normal signal path by means of buffer amplifiers. It is provided with precision 75Ω input and output terminations, and an overall gain of 1.5 dB. This means that 75Ω passive networks can be inserted without fear of reflection effects, and that gain is available to compensate for their basic loss. The calibration will then be correct whichever path is in use.

The advantages of this facility are illustrated by the following examples.

Noise Reduction by Band Limitation

It is not always realised that the random noise associated with a video signal often possesses a bandwidth extending surprisingly far above the nominal upper limit of the video band. This comes about because the video signal spectrum is limited by aperture and other effects, whereas the equipment handling it is commonly made to have a wide bandwidth to minimise distortion.

In such instances, it follows that the signal-to-noise ratio can be improved at the cost of only a small signal impairment by limiting the bandwidth to its nominal value by means of a delay-compensated lowpass filter of suitable design. This is especially effective with signals which have been transmitted over long microwave links where the noise spectrum tends to rise with increasing frequency, and the greater part of the noise power lies at the higher frequencies.

An example of this is given in the photographs of Figures 2a and 2b, where the spectrum of the random noise was quasi-triangular. In Figure 2a it is not really possible to be sure how much distortion exists at the base of the 2T pulse, whereas in Figure 2b where the signal has previously been passed through an FL4/557 lowpass filter of BBC design connected between AUX VIDEO OUT and AUX VIDEO IN, it is clear that one would proceed with a measurement with much more confidence. The improvement is even greater subjectively than appears from the photographs.

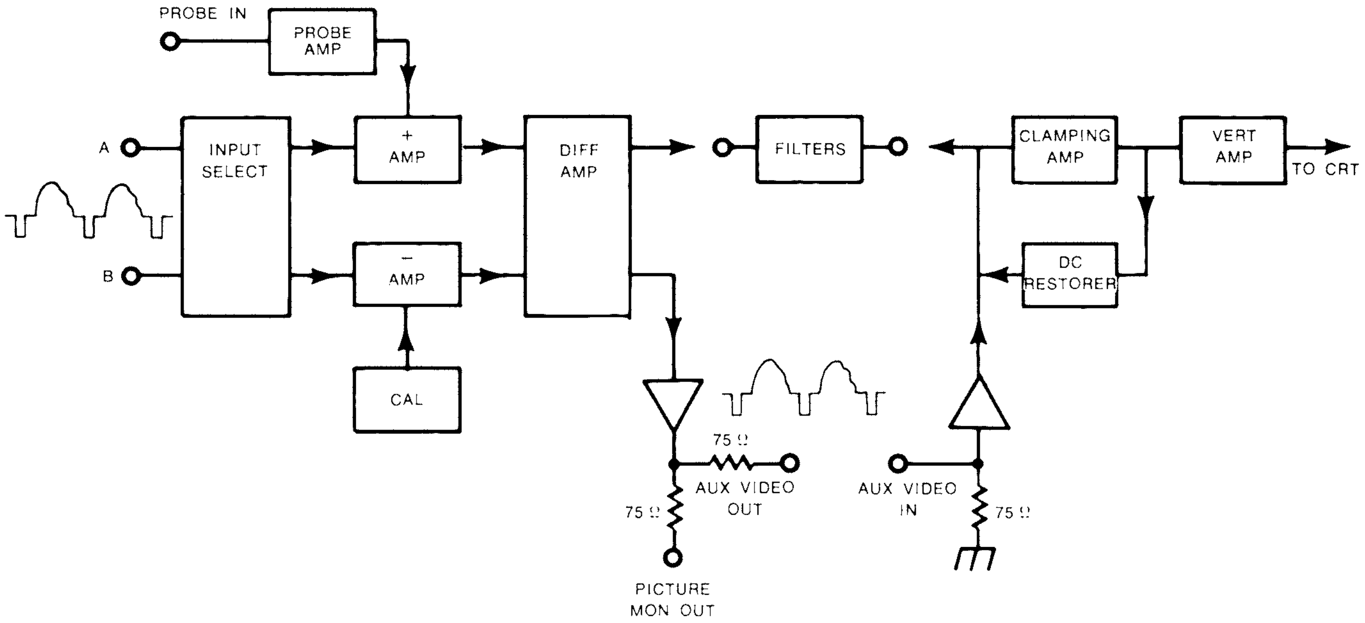
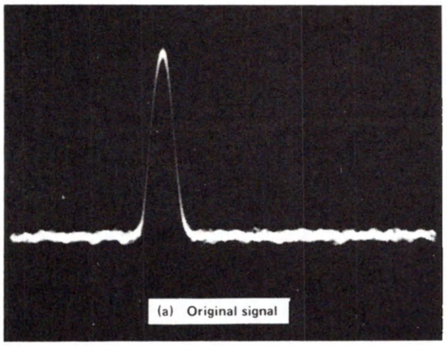


Figure 1. *Block Schematic of Auxiliary Video Facility.*


(a) Original signal

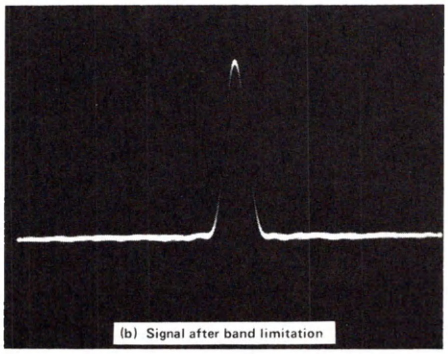

(b) Signal after band limitation

Figure 2. *Improvement in Signal-To-Noise Ratio by Band Limitation.*

The advantages of connecting the filter in the AUX VIDEO path are that it may be left in place as long as desired, ready to be called up at the turn of a switch, and that the distortion likely to be caused by connecting this type of filter between long coaxial cable lengths in a loop-through circuit is eliminated by the good 75Ω terminations provided by the AUX VIDEO path. Moreover, lowpass filters of this type have a considerable time delay, in this instance 500 ns, as can be seen by comparing Figures 2a and 2b. Any possibility of timing errors from such a delay in one signal path only is completely avoided by inserting the filter in the AUX VIDEO circuit.

Most usually, the basic loss of the filter is less than the 1.5 dB gain provided in the AUX VIDEO channel. It is then preferable to insert an attenuator pad of the correct value in series with the filter so as to make the AUX VIDEO gain unity while at the same time preserving the 75Ω circuit impedance. This will ensure that the calibration of the waveform monitor remains the same in both conditions of use. Details of suitable types of pad are given in Appendix I.

Insertion of Measuring Equipment

Video measuring equipment whose output requires a waveform monitor display can be inserted in series with the AUX VIDEO path whenever desired without breaking the input video feed. A case in point is described in some detail in Application Note #12, Part 4, where a TEKTRONIX 1478 Calibrated Chrominance Level Corrector is employed for the measurement of chrominance-luminance gain and delay inequalities. With this kind of connection it becomes possible to make measurements freely under in-service conditions with no fear that the use of the equipment will modify the video signal and become obvious to the viewer. For the same reason, the measuring equipment may be removed or interchanged without any effect on the video feed.

It is also possible to make use of the VIDEO OUT facility to drive another instrument simultaneously from the same signal. For instance, a vectorscope can be added when required without disturbing the normal utilisation of the waveform monitor.

Operational Networks

Tektronix has incorporated into the 1480-Series the widest practicable range of operational networks, that is chrominance and luminance separating filters, and so on. However, it is obviously not possible to anticipate all user requirements, and in fact it may well happen that these needs will change with time. The AUX VIDEO path provides the ability to add or to modify networks as the situation demands, thus ensuring a great deal of flexibility and a degree of protection against obsolescence.

Equaliser Design

Coaxial cable possesses a loss characteristic giving a steadily increasing attenuation with frequency, so in order to maintain the distortion at an acceptably low level it is necessary to equalise long cable runs. It will be shown that the AUX VIDEO facility can be utilised as a very simple and efficient means of designing these networks.

There are two approaches to video equaliser design. In the first, one measures the response to be equalised and then calculates the element values of the network best fitting the inverse of this response over the video band. In the second, advantage is taken of the fact that highly standardised TV test waveforms are now readily available, to obtain the equaliser values directly by inserting in series with the cable a variable network which is then adjusted until the output waveform is judged to have a sufficiently low degree of distortion. This latter method is very fast and economical, since the result is obtained immediately and without computation. It also has the great advantage that the effect of any small residual errors in the fit of the equaliser is automatically minimised, a benefit which could only be achieved by the first method with the aid of a complicated computer program.

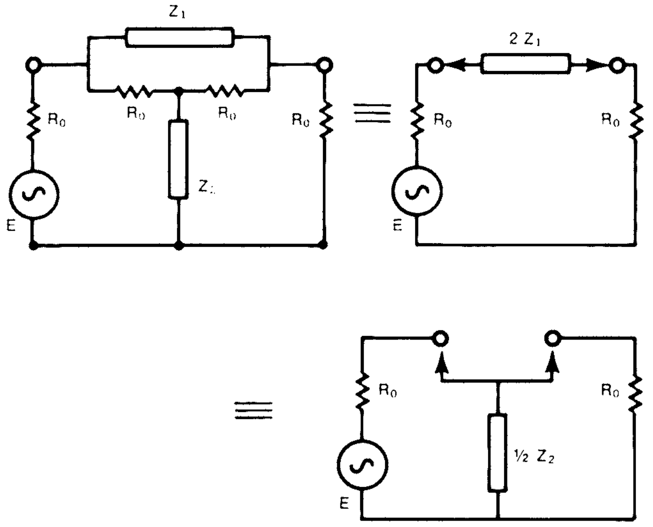
Principle of Variable Corrector

In general one would like to employ constant-resistance networks for equalization purposes since these may be inserted into a circuit of the same impedance without mismatch, and one is sure of obtaining the planned overall response. Unfortunately, even in their simplest forms they are quite complicated networks to make variable since in every instance a pair of arms has to be changed simultaneously so as to maintain the constant-resistance property.

However, there is an extremely useful, and largely neglected, simple relationship between the arms of a constant-resistance equaliser and the two-terminal network which, when inserted between a pair of equal resistances, gives the same insertion-loss characteristic.[1] This should be clear from the diagram (Figure 3).

Now the AUX VIDEO circuit in the 1480-Series provides just the requisite condition for the use of a two-terminal network as an equaliser, that is a pair of output and input impedances which are pure 75Ω resistances. It therefore becomes possible to construct a two-terminal network from variable resistors, capacitors and inductors which is capable of providing a very large range of loss characteristics when inserted in the AUX VIDEO path. Any one of these can then be converted immediately into the corresponding constant-resistance equaliser by a simple numerical process.

It might be mentioned that this is a very practical and efficient procedure which has been used professionally, in the U.K. for example, for the routine equalisation of coaxial cable circuits, and special equipment has been designed for the purpose.



$$Z_1 Z_2 = R_0^2$$

$$\text{Insertion loss} = 1 + \frac{Z_1}{R_0} = 1 + \frac{R_0}{Z_2}$$

Figure 3. *Equivalence between Constant-Resistance Equaliser and 2-Terminal Networks in Series and Shunt Insertion.*

Illustration of Design Procedure

Great care is taken with the 1480-Series to make sure that the gain is exactly the same in both the luminance and chrominance regions. However, when the monitor is installed the actual point at which the video signal is switched to its input is often physically separated from the input connector by an appreciable length of coaxial cable. It follows that the waveform monitor will have in effect a chrominance-luminance gain inequality which may be completely overlooked, and all chrominance amplitude measurements will be in error by that amount.

For instance, a typical high-quality flexible coaxial cable such as RG 59/U has a loss at 4.43 MHz of about 0.75 dB per 100 feet. Now as a result of the constraints of bay wiring it is very easy to have 20 feet or more of such cable between the waveform monitor input connector and a switching matrix, say in round numbers a chrominance-luminance gain inequality of 0.2 dB at the least. This is a significant error which should not be tolerated. The answer is to insert a simple constant-resistance equaliser in series with the input video feed.

The design procedure is as follows. The simplest equalisr configuration likely to give the required characteristic will always be chosen first. In this instance it will consist of a resistor and a capacitor in parallel for the series arm, as in Figure 4.

The next step is to select a value for the basic loss, that is the loss at zero frequency, which must obviously always be somewhat larger than the required subcarrier boost. For the sake of example this will be taken to be 1.5 dB, which is given in series insertion by a resistance of 28.3Ω. In most cases it is found easier to switch capacitors than inductors, so the series insertion form is preferred. This resistor is then connected between AUX VIDEO OUT and AUX VIDEO IN, and arrangements made to switch capacitors across it as required. The values for various subcarrier boosts are shown in Table I, for both 3.58 MHz and 4.43 MHz.

A video test signal generator providing a good sine-squared pulse and bar signal, such as the TEKTRONIX 148 for example, is then connected to the point where the video signal is normally applied, and a suitable display of the chrominance pulse (20T, 12.5T or 10T) obtained on the waveform monitor. Initially, with a resistor alone in the series arm, the baseline of the pulse will appear concave, but as the capacitance is increased from zero, this decreases until a point is reached where the baseline is as flat as in the input pulse. Multiplying this critical value by two gives the series arm capacitance of the constant-resistance equaliser.

The element values for the final equaliser can be calculated or taken from Table I. With these small values of correction its construction presents no real difficulties. The required capacitance can be synthesised by connecting values in parallel, and the inductance value can often be found to a sufficient accuracy in a series of commercial miniature wire-ended chokes.

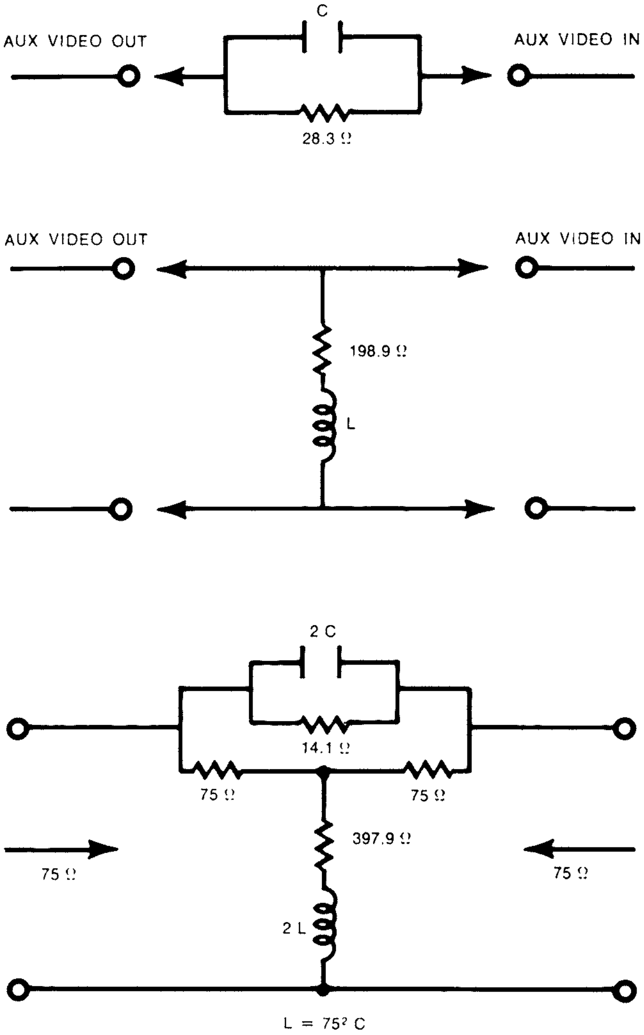


Figure 4. *Conversion of 2-Terminal Networks to the Equivalent Constant-Resistance Equaliser.*

The final step is to connect the equaliser in series with the waveform monitor and to readjust the gain to normal, since there will now be a loss of 1.5 dB in the circuit. This will present no problem if the monitor is used with a 75Ω termination since the loss can be made good simply by recalibrating the instrument with the preset variable gain control on the front panel, but with a loop-through connection it will become necessary to insert an amplifier. In this case, where video gain amplifiers are available to standard values such as 3 dB or 6 dB it will be most convenient to choose this value as the basic equaliser loss.

Table I

Values of 2C and 2L as a Function of Subcarrier Boost

	3.58 MHz		4.43 MHz	
Boost(dB)	2C(nF)	2L(μH)	2C(nF)	2L(μH)
0.1	0.91	5.1	0.74	4.2
0.2	1.34	7.6	1.08	6.1
0.3	1.71	9.6	1.38	7.8
0.4	2.06	11.6	1.67	9.4
0.5	2.42	13.6	1.96	11.0
0.6	2.79	15.7	2.26	12.7
0.7	3.20	18.0	2.59	14.6
0.8	3.67	20.6	2.96	16.7
0.9	4.20	23.6	3.39	19.1
1.0	4.85	27.3	3.92	22.1

Longer cable lengths can be equalised by exactly the same procedure, with the exception that the very simple configuration employed above will have to be replaced by a more complex structure. The one recommended does not in fact follow the desired law of attenuation particularly well, but where the loss at subcarrier frequency is no more than, say, 1 dB, the errors are negligibly small and any greater complexity of the equaliser arm is not justified by any improvement in performance. Details of networks suitable for cable equalisation in general can be found in suitable texts[1,2].

Impedance Transformation

The AUX VIDEO connector provides an output with a 75Ω source impedance and the same polarity as the output for any of the inputs to the waveform monitor. In particular, it may be used in conjunction with the X 10 probe as an impedance transformer between a very high and a 75Ω impedance. This is invaluable when one wishes to drive another instrument with a 75Ω input impedance, from a probe, for instance a TEKTRONIX vectorscope.

Conclusions

The examples given above are typical of the uses to which the AUX VIDEO facility can be put, and clearly demonstrate the potential it possesses for increasing the field of utilisation of the 1480-Series of Waveform Monitors. It is hoped they will suggest further ideas for employing this facility in the solution of operational and other problems.

References

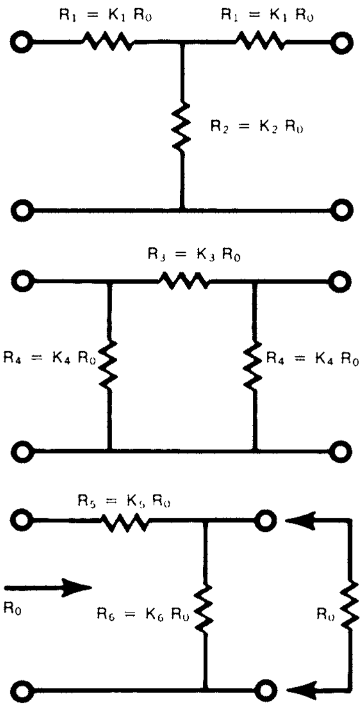
1: Bode: Network Analysis and Feedback Amplifier Design, D. Van Nostrand 1945.

2: Landee, Davis and Albrecht: Electronic Designer's Handbook, McGraw Hill, 1952.

Appendix 1

Resistance Values for 75Ω Attenuator Pads

dB Loss.	R_1 (Ω)	R_2 (Ω)	R_3 (Ω)	R_4 (Ω)	R_5 (Ω)	R_6 (Ω)
0.1	0.43	6.51k	0.86	13.0k	0.86	6.48k
0.2	0.86	3.26k	1.73	6.51k	1.71	3.22k
0.3	1.30	2.17k	2.59	4.34k	2.55	2.13k
0.4	1.73	1.63k	3.46	3.26k	3.38	1.59k
0.5	2.16	1.30k	4.32	2.61k	4.20	1.27k
0.6	2.59	1.08k	5.18	2.17k	5.01	1.05k
0.7	3.02	929	6.05	1.86k	5.81	894
0.8	3.45	813	6.92	1.63k	6.60	777
0.9	3.88	722	7.79	1.45k	7.38	687
1.0	4.31	650	8.65	1.30k	8.16	615
1.1	4.74	591	9.52	1.19k	8.92	556
1.2	5.17	541	10.39	1.09k	9.68	506
1.3	5.60	499	11.27	1.00k	10.46	465
1.4	6.03	463	12.14	932	11.16	429
1.5	6.46	432	13.02	871	11.90	398



SYMMETRICAL T-PAD

$$K_1 = \frac{A - 1}{A + 1};\ K_2 = \frac{2A}{A^2 - 1}$$

SYMMETRICAL π-PAD

$$K_3 = \frac{A^2 - 1}{2A};\ K_4 = \frac{A + 1}{A - 1}$$

ASYMMETRICAL PAD
(must be terminated as shown)

$$K_5 = \frac{A - 1}{A};\ K_6 = \frac{1}{A - 1}$$

A = INSERTION VOLTAGE RATIO = ANTILOG 0.05 (dB LOSS).

Figure 5. *Design of Attenuator Pads.*

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note 20

A NEW NTSC GRATICULE FOR THE 1480 WAVEFORM MONITOR

(Operational Measurements Using a New NTSC Composite Graticule)

By
Charles W. Rhodes and
John Lauer

The modern display features of the TEKTRONIX 1480 Waveform Monitor have been further enhanced by a new, versatile NTSC graticule. Many linear transmission distortion measurements that have been difficult or inconvenient can now be made with relative ease. The uncluttered scale design and well thought out organization of this new graticule yield consistently accurate results with a minimum of control setting changes.

Graticule A

Vertical Scales. The vertical scale of this new NTSC composite graticule extends from −50 to +120 IRE Units in 10 IRE Unit increments. In addition, three separate 2 IRE Units/div scales are provided at strategic locations for rapid, precise measurements of key signal parameters. A dashed line at 7.5 IRE Units, or 7.5%, is provided for use as a black level setup reference.

The right-side scale, for measuring transmitter % of modulation, extends from 0%, at the +120 IRE Unit line, to 100%, at the −40 IRE Unit line. The 0 (zero) IRE Unit reference line, which contains horizontal divisions, is subdivided for measurement of time.

Horizontal Scales. The horizontal reference line at 0 IRE Units is 12.7 divisions long. Using the 5 μs/DIV time base, the time base line is 63.5 μsec (1H) long.
The 10 μs/DIV time base provides a time base of 127 μsec (2H). This makes it possible to calibrate the 5 and 10 μs/DIV time bases using the TV signal.

The −30 IRE Unit line contains nine divisions, which correspond to one-half of the period of a cycle of NTSC burst at 100 nsec/div. At 200 nsec/div, the divisions or "tick marks" equal the period of one cycle of burst. These relationships make it possible to accurately calibrate the 100 and 200 nsec/div time bases, using the convenient NTSC color burst.

Also located on the 0 IRE Unit horizontal reference line are points T and B. Point T is for use in measuring rise and fall-time. It lies directly below point R and denotes the time zero when the 90% point of a 100-IRE Unit rising transient, or 10% of a 100-IRE Unit falling transient, intersects point R (at the 80-IRE Unit line).

If there is any serious tilt of the blanking level, there is ambiguity in the setting of the blanking level to the 0 IRE reference level. To remove that ambiguity, a study group of the CCIR (CMTT/187-E) has recommended that insertion gain be measured between the center of the white bar and a blanking level reference point. On Graticule A, this blanking level reference point is labeled B.

Internal and External Graticules. Two graticules are installed in each 1480. Selective illumination of either graticule allows the user to, in effect, choose the appropriate graticule for his measurement.

Parallax errors are entirely avoided when an internal graticule is used. The external graticule, however, is subject to parallax error. This error can be eliminated, when taking waveform photographs, by using an external graticule designed to correct for parallax. Tektronix provides such graticules and strongly recommends them for waveform photography. Labeled Photographic, they should only be used for waveform photography because they are designed to compensate for about 3% parallax error. Using an external graticule (same scale size as the internal graticule) for visual monitoring will provide a parallax error of 1% or less. Visual (unmarked) graticules should not be used for waveform photography.

Using Graticule A

The primary test signal in this application note is an NTSC composite test signal, generally a Vertical Interval Test Signal (VITS). The composite test signal can be either the one required by the FCC (§73.669) for remote transmitter control or the CCIR composite VITS for international program exchange (CCIR Recommendation 473, Annex II, 525-line systems, adopted 1974).

While the graticule special scales provide 2% resolution increments at 1.0 VOLTS FULL SCALE, greater resolution is provided by the 1480 Waveform Monitor's calibrated vertical expansion. A 1.0 volt video signal can be expanded 2X or 5X without loss of accuracy, providing direct resolution of up to 0.2% for some of the measurements that follow.

Calibration Checks. Time base calibration accuracy can be checked with just the video signal. The 5 and 10 μs/DIV time bases are checked by measuring the time duration of 1 or 2 lines (63.5 μsec or 127 μsec). The 0.1 and 0.2 μs/DIV time bases are checked by measuring burst period against the scale (tick marks) on the −30 IRE Unit line.

Vertical gain, which may be reset from the front panel, is easily checked by using the 1480's built-in calibrator. Television Application Note 11, "The Measurement of Signal Level With the 1480-Series of Waveform Monitors," by L. E. Weaver, discusses an extremely accurate method of setting vertical gain.

Insertion Gain

In all measurements using television test signals, whether full field or VITS, signal level or insertion gain must be checked first. The vertical sensitivity of the 1480 should first be checked, 1.0 V equals 140 IRE.

Use the 5 μs/DIV time base to display

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the composite test signal. Position the leading edge of the bar to the ascending arrow. Vertically position the blanking level to point B on the 0 IRE Unit reference line.

Insertion gain is measured at the bar midpoint. see *Figure 1.*

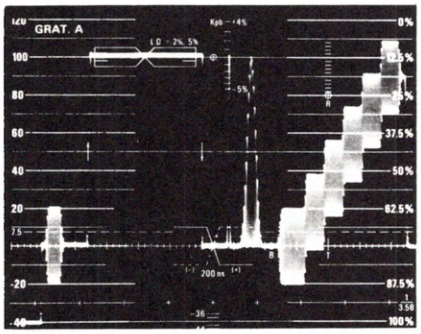

Figure 1. *Checking Insertion Gain and Line Time Distortion. Insertion Gain = unity, L.D. = 0%.*

Line Time Distortion

Position the composite test signal bar leading edge to the ascending arrow. with blanking level on point B. If insertion gain is off. set the VARiable VOLTS FULL SCALE so that the bar top passes through 100 IRE at its midpoint. See *Figure 1.* To measure line time distortion, check the largest deviation of the bar top (tilt or rounding) within the box. This box ignores the first and last 1 µsec where short time distortions may be observed. The box provides 2% and 5% L.D. (line time distortion) scales.

To increase resolution. change the VOLTS FULL SCALE (without changing VARiable VOLTS FULL SCALE) to 0.5 for 2½% and 1% limits to the L.D. measurement box. or to 0.2 for 1% and 0.4% limits. See *Figure 2.*

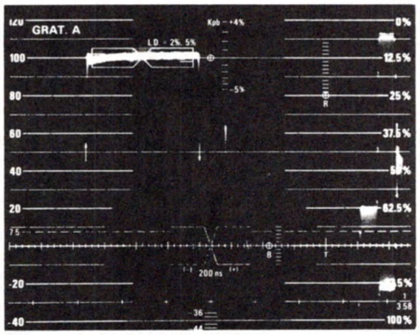

Figure 2. *Line Time Distortion with increased gain, L.D. = 0.4%.*

Short Time Distortion

At the time of this writing. the weighting characteristics to be used to develop an outline for the 2T pulse and the T step transition are under discussion by industry committees. For this reason, Graticule A does not contain the traditional outline for the 2T pulse. Instead. an external graticule (Graticule B). containing a scaling of the outline given in CCIR Recommendation 421-1. is provided for 1480's equipped with Graticule A. If a different weighting factor is adopted for 525/60 standards. new graticules and different nomenclature will be required. Current plans call for changing the 2T pulse distortion nomenclature to P_{2T}. and T step distortion nomenclature to S_{1T} to reflect these different weighting factors.

Many broadcast organizations presently use and are familiar with (2T) pulse-to-bar amplitude ratio measurements and. for this reason. the K_{pb} scale is included on this new graticule. The K_{pb} scale is nonlinear. It conforms with CCIR Recommendation 421-1.

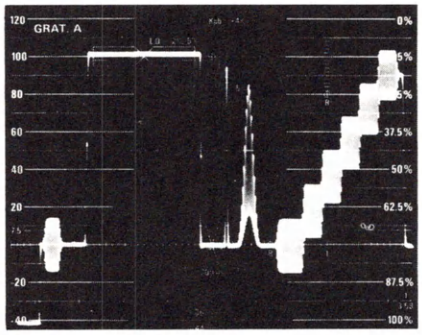

Figure 3. *K_{pb} measurement, $K_{pb} = -1.5\%$.*

K_{pb}. To measure pulse-to-bar ratio. place the composite test signal bar leading edge over the ascending arrow and the blanking level on the 0 IRE Unit reference line at point B. If insertion gain is incorrect (bar midpoint not at 100 IRE). use the 1480 VARiable VOLTS FULL SCALE to correct this condition.

The pulse-to-bar measurement is from bar midpoint to peak 2T pulse amplitude expressed in + or − percent. See *Figure 3.*

K_{2T}. If insertion gain is incorrect. adjust the VARiable VOLTS FULL SCALE to compensate. Use a 200 nsec/div time base and position the 2T pulse beneath the K_{2T} scale. This measurement uses Graticule B. To illuminate the external Graticule B. pull the Scale Illumination knob. *See Figure 4.*

The mask corresponds to 5%. If greater resolution is desired. change the VOLTS FULL SCALE (without moving VARiable) to 0.5 for 2½% or 0.2 for 1% mask limits. See *Figure 5.*

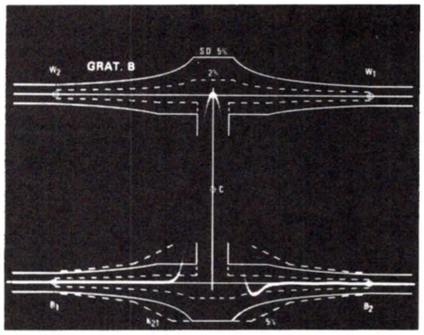

Figure 4. *K_{2T} measurement. $K_{2T} = 2\%$.*

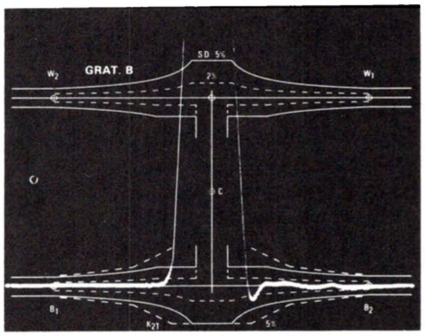

Figure 5. *K_{2T} measurement with increased gain, $K_{2T} > 1\%$.*

Short Time Waveform Distortion (SD). IEEE Trial Standard 511-1974 describes the technique for measuring short time waveform distortion (SD) in detail. Graticule B includes the mask prescribed in the Trial Standard. The 1480's POSITION controls are adjusted so that the transition passes through points B (blanking) and C. and the vertical gain is set so that white level of the bar passes through point W. Some control interaction will take place. Using the 200 nsec/div time base. an undistorted 1T transition will lie perfectly centered in the mask. See *Figure 6.*

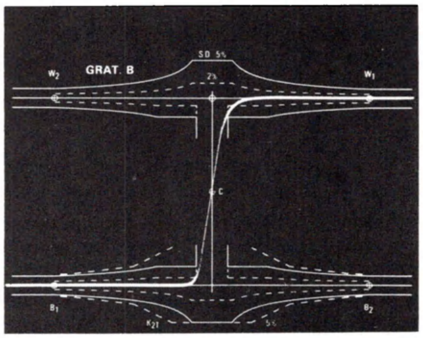

Figure 6. *S.D. using 2T pulse rising transient, S.D. ≈ 2%.*

The FCC Composite VITS (§73.699. *Figure 15)* provides for a 2T bar. This signal cannot be used to measure SD. It does. however. include a 2T pulse which may be used to measure SD using the 2T pulse mask of Graticule B. See *Figure 4.*

A 5% value of SD is used as the basis of the mask in Graticule B, again this is in conformity with the IEEE Trial Standard 511-1974.

In a linear system, one need only measure one transition (rising or falling), but in practical circuits, non-linear distortions may affect the transitions very differently. This provides a clue to the presence of such non-linear distortions. It is good, therefore, to measure both transitions. Each might be characterized by a different value of SD.

Chrominance—Luminance Gain Inequality

Check insertion gain. If it is not unity, use the VARiable VOLTS FULL SCALE to get a 100-IRE Unit blanking-to-bar center amplitude. Use a 1 μs/DIV time base and check the peak amplitude and baseline offset of the 12.5T modulated sine-squared pulse. If other forms of distortion are not present, the variation in peak amplitude and the baseline offset, at pulse center, will be equal. See *Figure 7.*

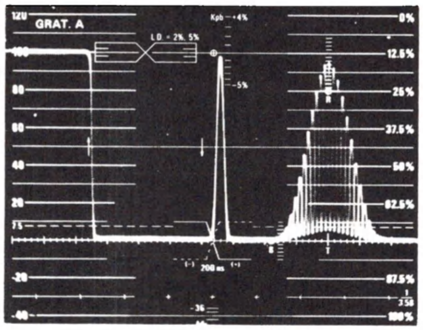

Figure 7. *Chrominance to Luminance Gain Inequality measurement, C/L Gain Inequality = 9%.*

Assuming that the 12.5T pulse baseline is symmetrical (negligible chrominance—luminance delay), as shown in *Figure 7,* gain inequality can be measured using either the vernier scale (−10 to +10 IRE) or the R scale to the right of the pulse. Each division of these scales equals 2 IRE Units. Chrominance—luminance (chrominance-to-luminance) gain inequality is equal to twice the difference between 100 IRE Units and peak displayed amplitude of the 12.5T modulated sine-squared pulse, expressed in percentage.

This measurement can also be made by using a TEKTRONIX 1478 Calibrated Chrominance Level Corrector in the 1480 Aux Video Out-Aux Video In configuration. (See Television Application Note #17, "The Auxiliary Video Facility of the 1480-Series of Waveform Monitors," by L. E. Weaver.)

Chrominance—Luminance Delay

If the chrominance—luminance gain inequality is negligible, or has been annulled, for example, using the TEKTRONIX 1478 Calibrated Chrominance Level Corrector (See Television Products Application Note #10, "Chrominance to Luminance Gain Correction and Delay Measurements"), chrominance—luminance delay inequality can be read directly from Graticule A.

Use a 1 μs/DIV time base and horizontally center the 12.5T modulated sine-squared pulse. Set displayed pulse amplitude for 100 IRE Units (blanking level to pulse peak amplitude), if necessary. Vertically set the blanking level on the graticule 0 IRE Unit reference line. See *Figure 8.*

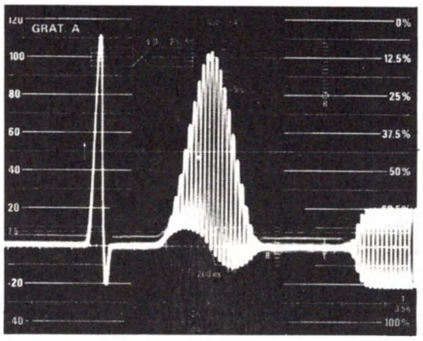

Figure 8. *Chrominance to Luminance Delay Inequality measurement, C/L Delay Inequality = 200nsec.*

If, as in *Figure 8,* chrominance—luminance gain inequality is negligible, chrominance—luminance delay inequality is easily measured by comparing the symmetrical sinusoidal baseline abberation to the special delay scale. The plus-to-minus transition (solid line) is used with a positive chrominance delay (chrominance lag), while the minus-to-plus transition (dashed line) is for negative chrominance delay (chrominance lead). A full scale symmetrical transition, such as the one in *Figure 8,* equals 200 nsec of delay inequality.

Since chrominance—luminance delay inequality may be considerably less than 200 nsec, the calibrated vertical expansion of the 1480 Waveform Monitor allows two and five times resolution increase. Setting VOLTS FULL SCALE to 0.5 changes the delay scale to 100 nsec peak-to-peak; 0.2 VOLTS FULL SCALE increases the delay inequality scale resolution to 40 nsec. See *Figure 9.*

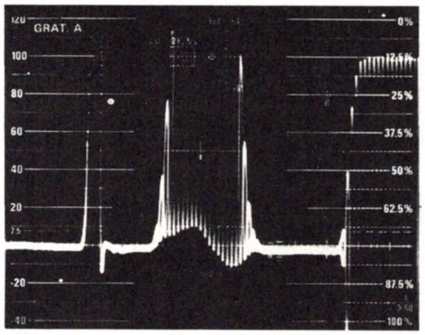

Figure 9. *Chrominance to Luminance Delay Inequality measurement, with increased gain, C/L Delay Inequality = 40 nsec.*

Luminance Non-linearity

Luminance non-linearity is easily measured using the differentiated step display mode of the 1480 Waveform Monitor. Position the composite waveform staircase to graticule center and switch to DIFF'D STEPS. Adjust the VARiable VOLTS FULL SCALE for a 100 IRE Unit amplitude of the largest step (spike). See *Figure 10.*

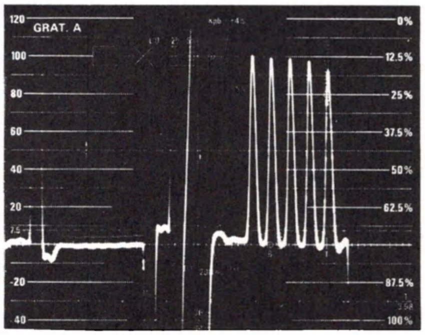

Figure 10. *Luminance Non-linearity measured with the Differentiated Step Display, Luminance Non-linearity = 6%.*

Horizontally position the smallest step (spike) to the R scale (2 IRE Units/div) and read the percentage of non-linearity directly. The formula for determining luminance non-linearity, in %, according to the CCIR, is $1 - \frac{m}{M} \times 100$. M is the amplitude of the largest step, and m is the smallest step. This formula is conveniently simplified by holding M at 100 and subtracting m, or 100 − m.

It is also possible to fold back the 1480's sweep to display m and M overlayed. (See Television Application Note #13, "Time Base Fold Back, A Novel Improvement Over Double Triggering for Video Testing" by Charles W. Rhodes.)

Risetime and Falltime

Graticule A has built-in rise and fall time measurement capability. Point R at 80 IRE Units aligns with T on the 0 IRE Unit reference line. See *Figure 11.*

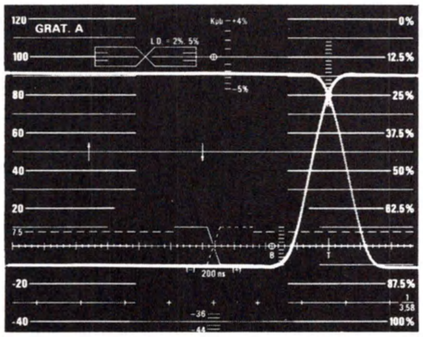

Figure 11. *Double exposure showing the measurement of rise and fall times of a T step, T_r and $T_f = 120$nsec.*

To measure rise or fall time, set the transition amplitude to 100 IRE Units (use the VARiable VOLTS FULL SCALE). Vertically position the display so that the transition is from the −10 IRE Unit line to the +90 IRE Unit line. Use the 100 nsec/div time base and horizontally position the rise (or fall) of the transition through point R on the short 2 IRE Unit/div scale. Measure the distance from point T on the 0 IRE Unit reference line to where the transition crosses the reference line. Time/div is 100 nsec: the T step transitions shown in *Figure 11* have a rise and fall time of 125 nsec.

In a linear system, risetime and falltime of the bar signal are equal. Non-linearities may affect risetime and falltime unequally. Measuring both by the above method detects such non-linear effects.

Bar Trail or Smear

Bar trail occurs after a transition from white to black. It is discussed in some detail in CMTT Document/189E: however, it need only be discussed here as the picture impairment appearing as streaking, following white-to-black transitions. To measure bar trail, use the 100 nsec/div time base. Position the trailing edge of a 100-IRE Units step transition (0-100 IRE Units on graticule) through the descending arrow (at the 50 IRE Unit line intersection) and measure displacement on the + and −10 IRE scale just to the right of point B. This scale is properly located for 525/60 standards.

Figure 12 shows the bar trail measurement using the white-to-blanking level transition of the staircase. A transition of 250 nsec falltime must be used because faster falltime (1T) may display ringing, which would confuse the measurement.

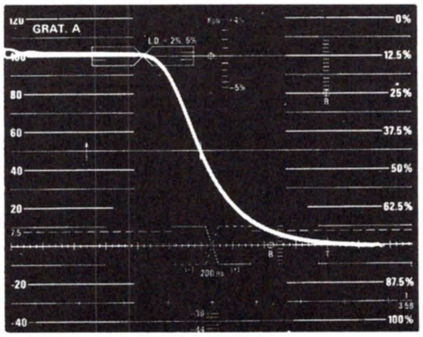

Figure 12. *The Bar Trail measurement, Bar Trail = 5%.*

The remote transmitter control composite VIT Signal (FCC §73.669) has 250 nsec step transitions for the white bar and the falling transition of the bar may be used.

Measuring Half-Amplitude Duration of a Pulse

Adjust the VARiable VOLTS FULL SCALE for a pulse amplitude of 100 IRE Units. Shift the pulse down until the peak is at the 50 IRE Unit line. See *Figure 13.* The Graticule 0 IRE Unit reference line now intersects the pulse at the half-amplitude point.

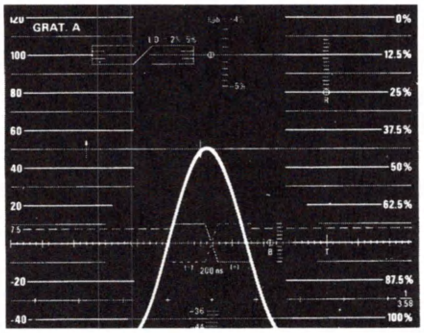

Figure 13. *Half-amplitude Duration (H.A.D.) measurement of a 2T pulse, H.A.D. = 245nsec.*

By selecting the proper time base, the half-amplitude duration (HAD) of the pulse is directly measured on the 0 IRE Unit reference line. Use a 100 nsec/div time base for a T or 2T pulse, and a 500 nsec/div time base for a 12.5T modulated sine-squared pulse.

Sync Amplitude

Sync amplitude error can be read directly, using the scale at the center of the −40 IRE Unit graticule line. This scale is marked at −36, −38, −40, −42, and −44 Units, or −10%, −5%, 0%, +5%, and +10%, respectively. It is located in time so that it can be used with either the 10 μs/DIV or 2 FIELD DISPLAY with equal accuracy.

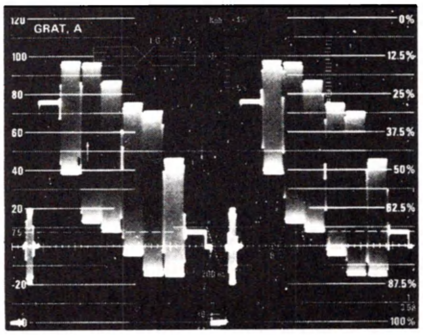

Figure 14a. *Horizontal (line) Sync Amplitude measurement, Sync Amplitude = 40 IRE.*

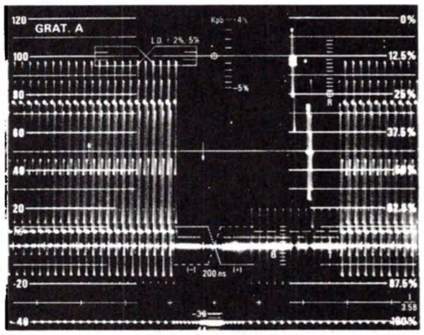

Figure 14b. *Vertical (field) Sync Amplitude measurement, Sync Amplitude = 40 IRE.*

Vertically place the blanking level of the composite video waveform on the graticule's 0 IRE Unit reference line. Check insertion gain and then read horizontal sync amplitude using the 10 μs/DIV time base *(Figure 14a)*, or vertical sync amplitude using the 2 FIELD DISPLAY *(Figure 14b)*.

Tests With Other Signals

Amplitude Versus Frequency Response. A simple technique for checking frequency responses uses the multiburst signal to check for amplitude variations at the different frequencies. See *Figures 15a and 15b.* Care must be used in interpreting results of measurements made with the multiburst signal because it is not uncommon to note harmonic distortion on one or more of the bursts.

Even-order harmonics cause inequality between positive and negative peaks. Therefore, if the amplitude of only one of the peaks is measured, incorrect results will be obtained. Measure both the pedestal to positive peak and pedestal to negative peak to determine if even-order harmonic distoration is present.

Odd-order harmonic distortions affect

both peaks in the same manner, causing the peak-to-peak amplitude to be either too high or too low. The peak-to-peak amplitude depends on whether the 3rd harmonic can pass through the system. High frequency phase shift of this 3rd-order harmonic will cause the peak-to-peak amplitude of the burst to be distorted.

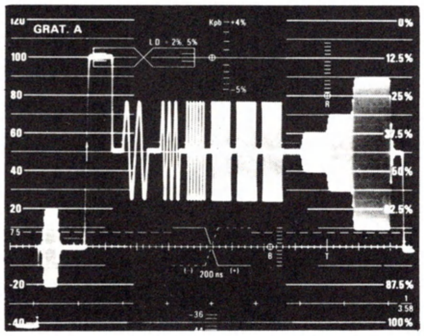

Figure 15a. *Combination of Multiburst and Modulated Pedestal signals.*

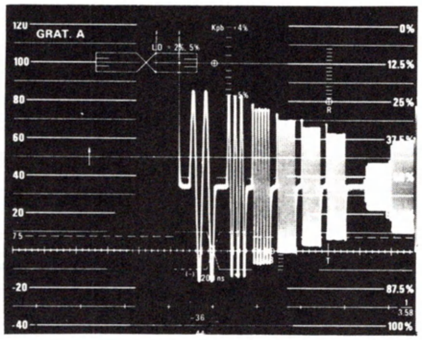

Figure 15b. *Amplitude/Frequency Response 3 dB down at 3 Mhz.*

The multiburst signal shown in *Figures 15a and 15b* is the combined multiburst and modulated pedestal signal also described in CCIR Recommendation 473, Annex II. Vertically position the multiburst signal blanking level to the 0 IRE Unit reference line and use the VARiable VOLTS FULL SCALE to adjust for a white flag amplitude of 100 IRE Units. Set the 1480 VOLTS FULL SCALE to 0.5 (burst amplitude equals 100). Check for equal amplitude of the multiburst packets above and below the pedestal (even-order harmonic distortion). To measure the frequency response, successively position the negative peak of each multiburst packet to the 0 IRE Unit reference line and measure the peak positive amplitude of the packet.

Color Bar Chrominance Amplitude

The chrominance amplitude of 75% amplitude color bars can be rapidly checked on the new graticule using the R scale. There are only three chrominance amplitudes present in the six color bars: 62, 82, and 88 IRE Units. See *Figure 16.*

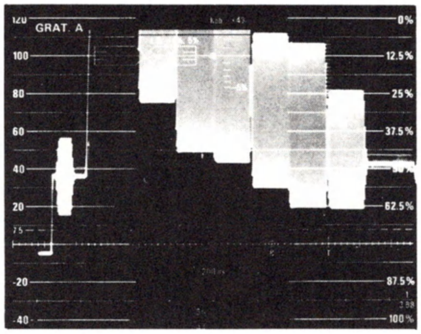

Figure 16. *Measuring Color Bar Chrominance Amplitude of the red and blue color bars, Amplitude = 88 and 62 IRE respectively.*

To measure each color bar amplitude, place the negative peak of the bar on the 20 IRE Unit graticule line, below the R scale. The displayed peak amplitudes become 82, 102, and 108 IRE Units respectively for the 62, 82, and 88 IRE-Unit-amplitude color bars.

Using Burst for Waveform Monitor Timing Check. Timing accuracy can be quickly verified by comparing the duration of burst cycles against the timing scale on the −30 IRE Unit graticule line. See *Figure 17.*

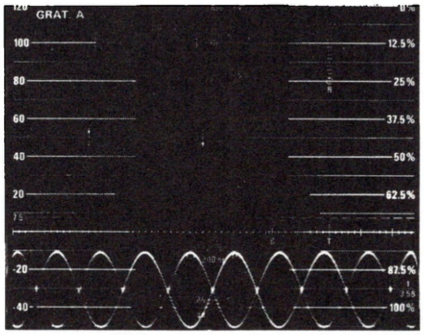

Figure 17. *Time Base Accuracy check at 100 ns/division sweep rate.*

Use either a 100 or 200 nsec time base and check for duration of each cycle of burst. This is a very accurate method to verify or calibrate (see 1480-Series Waveform Monitor Instruction Manual) the 1480 time base without special test equipment.

The discussion of test methods in this application note points out that proper design of the graticules for waveform monitors promotes versatility and accuracy. The new Graticule A used with the 1480 Waveform Monitor, provides great versatility and accuracy without clutter—a feature operating personnel will appreciate. Some early 1480-Series Waveform Monitors (including 1485 Dual Standard models) may not be equipped with this graticule. If you desire an external version of this graticule, contact your nearest TEKTRONIX field office or representative for assistance.

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technical excellence

12/75

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Tektronix®
COMMITTED TO EXCELLENCE

USING THE 1480-SERIES WAVEFORM MONITOR

television application note no. 21

All Fields Display to Improve NTSC In-Service Testing

by John Lauer

Since their introduction, the use of Vertical Interval Test Signals for in-service measurements has revolutionized television transmission system measurement techniques. For the first time it became possible to comprehensively assess distortions caused by the transmission system while the system was in use. To further these techniques a feature that permits, for example, the simultaneous display of VITS occuring on all fields has been incorporated in the 1480-Series Waveform Monitor. In instruments of this series designed for use on PAL, where four pushbuttons uniquely select the four fields of the PAL signal, a separate pushbutton-selected function labeled ALL FIELDS is provided. Instruments designed for NTSC, on the other hand, will have two field-selection pushbuttons and when both are depressed the display is selected. This new display mode presents three distinct advantages:

1. Simultaneous viewing of VITS.
2. Transmission system analysis through comparison of VITS inserted at separate points.
3. A novel in-service field time distortion measurement technique.

Other useful applications of this new and versatile feature may be developed to go along with the demands of ever more sophisticated measurements.

Simultaneous Viewing of VITS

With the TEKTRONIX 1480-Series Waveform Monitor's All Fields display mode, the Vertical Interval Reference Signal (VIRS), two or four VITS, or a combination of both VITS and VIRS on both fields can be viewed simultaneously. The Display and Magnifier switches determine how many vertical interval lines are displayed.

To display one line from each field start by setting the DISPLAY switch to 5 μs/DIV to provide a single tv line (1H) display. Activate the line selection by depressing the DIG (digital) pushbutton and set the LINE SELECTOR for the desired line. Then to obtain the All Fields display, push in both FIELD selection pushbuttons. (For PAL equipped instruments depress the ALL FIELDS pushbutton, located in the lower right corner of the front panel).

Setting the DISPLAY switch to 10 μs/DIV provides two successive lines (2H) from each field. The line selected by the LINE SELECTOR setting and the one following it are displayed. See Figure 1.

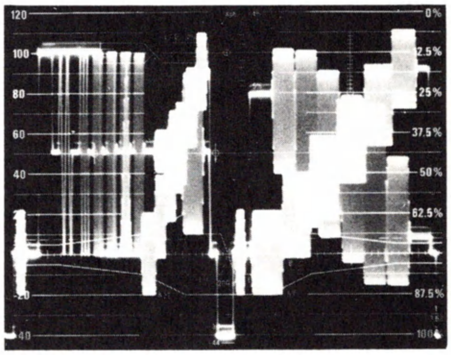

Figure 1. *Two VITS lines from each field.*

A novel way to display all signals inserted on lines 17 through 20 of both fields is to set the DISPLAY switch to 2 FIELD and set the MAG to X50. Depress both of the FIELD selection pushbuttons (or in the case of PAL instruments, push in the ALL FIELDS pushbutton) and horizontally position the start of the trace onto the screen. Note that the VITS (and VIRS) are displayed only at the start of the sweep when 2 fields are displayed in the All Fields mode. Figure 2 shows the display of line 17 and 18 VITS plus the VIRS on line 19.

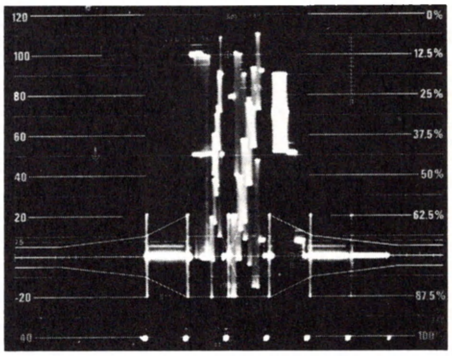

Figure 2. *Lines 17, 18, (VITS) and 19 (VIRS) from each field.*

Comparative Distribution System Analysis

It is relatively easy to assess the distortion of an entire distribution system by using, for example, K-rating of the VITS added at the point of origin. However, this does not localize individual problems in the system. While not new, the idea of inserting test signals at different points in the system and comparing them takes on a new dimension when the test signal can be directly overlaid for comparison rather than make tedious measurements with the graticule. The All Fields display mode, makes it possible to overlay the same line in both fields in order to compare waveform distortions which have occured over the entire system and those which arose in only a portion of the system.

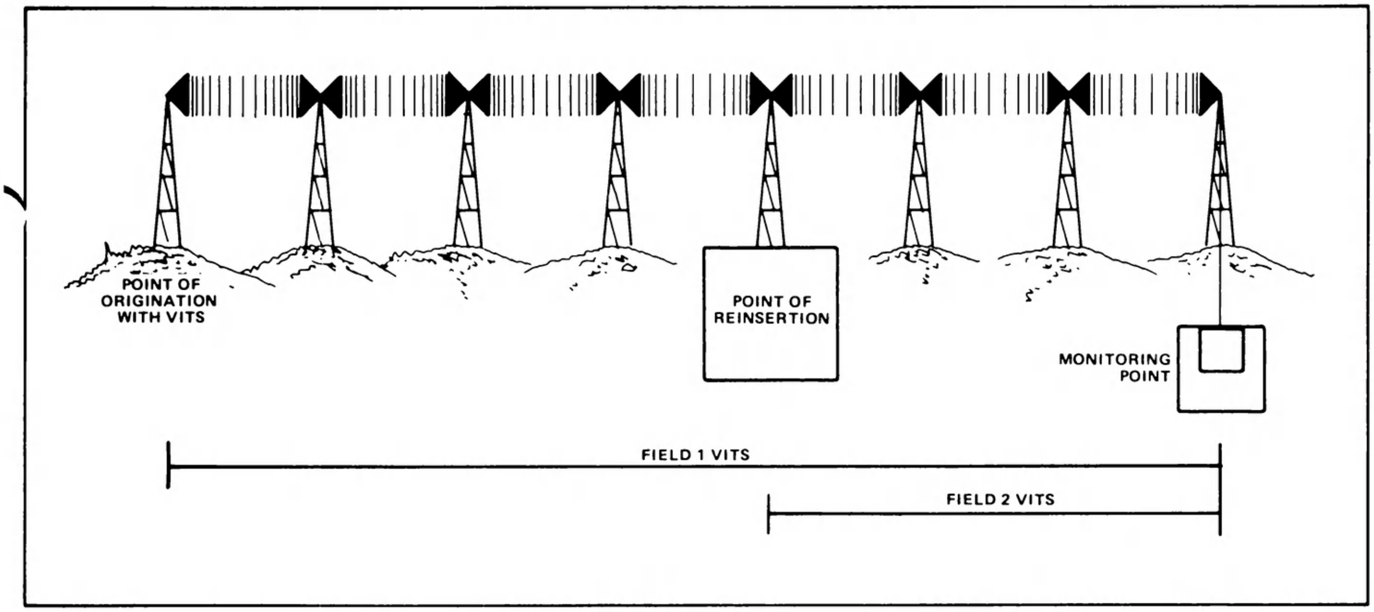

Figure 3. *VITS insertion for distribution system analysis.*

This display mode opens up an interesting test method for distribution system analysis. All that is required, in addition to the display, is a method to insert on the same line of the opposite field, the identical test signal. Precautions must be taken that the outputs of any test signal generators used for this purpose are as closely matched as current technology permits, including the adjustment of VITS timing relative to sync. The TEKTRONIX 149/149A NTSC Test Signal Generator has a front panel adjustment labeled INSERT DELAY, that is adjusted, in this case, for coincidence of both VIT Signals. This matching of generators is an excellent use of the 1480-Series All Fields display, with one generator inserting on one field and the other inserting on the opposite field.

For purpose of examination, the composite test signal specified by the CCIR[1], for international exchange of program material, is substituted on field 2 line 17 for the VITS normally inserted on that line. To further simplify this illustration the field 1 VITS will traverse the entire system, while field 2 VITS are, for this purpose being reinserted at some down stream point.

The technique is universal in that the size of the system under test can be anywhere from a studio-to-transmitter link to a transcontinental network. By locating the 1480-Series Waveform Monitor downstream from the reinsertion point, three distinct pieces of information are readily available:

1. Overall system distortion.
2. Distortion occuring between original insertion point and reinsertion point.
3. Distortion occuring between the reinsertion point and the monitoring point.

The overall system distortion is easily assessed from the K-rating of the line 17 field 1 composite test signal that has traversed the entire system and will show the total amount of distortion throughout the system. The K-rating of the line 17 field 2 composite signal provides a measure of the distortion occurring between the reinsertion point and the monitoring point. When both fields are overlayed, display, the difference in the signals is the measure of the distortion occuring between the origination and the reinsertion point.

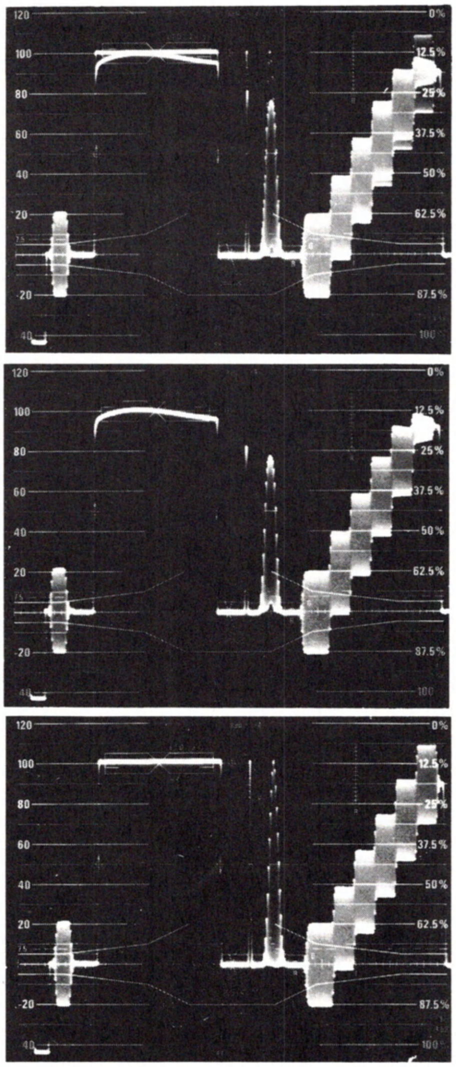

Figure 4. *VITS comparison: a. Line 17 VITS from both fields.*
b. Line 17 VITS from field one.
c. Line 17 VITS from field two.

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[1] CCIR Recommendation 473, Annex 2 (525 line systems) adopted 1974.

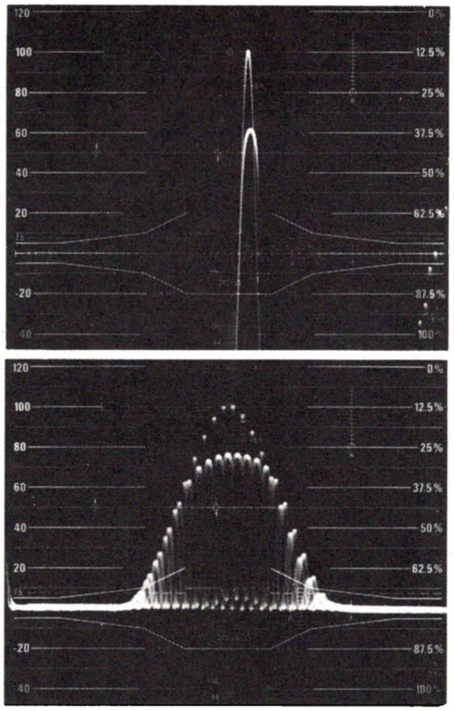


Figure 5. *a. Comparison of 2T pulses from both fields (0.2 Volts Full Scale).*
b. Comparison of 12.5T pulses from both fields.

VIR Signal Comparison

Another use of the All Fields display mode allows the comparison of in-house generated VIRS (which may be used as a reference waveform once it has been determined that the locally generated VIRS is within tolerance) to the incoming program line VIRS. Set the in-house VIRS inserter to strip and reinsert on one field only. Set the 1480-Series Waveform Monitor LINE SELECTOR to line 19 and depress both FIELD selection pushbuttons (or the ALL FIELDS pushbutton on PAL equiped instruments) for VIRS comparison. This comparison is not intended for diagnostic purposes, but rather to help alert an operator to a potential problem or to allow him to adjust signal parameters. The program video should not be subjected to this deletion of the program related VIRS or the reinsertion of a locally generated VIR Signal. This comparison technique should only be done on a monitoring circuit and not on the program line itself.

Observing Field Time Distortion

It has not been practical, until now, to make in-service field time distortion (tilt) measurements. With the All Fields display mode of the 1480-Series Waveform Monitor it can be done with relative ease.

The accuracy of this measurement will be somewhat less than the current white bar test method used in full field, but this is to be expected since much less energy will be contained in a VIT Signal. Figure 6 shows field time distortion measured with a white bar.

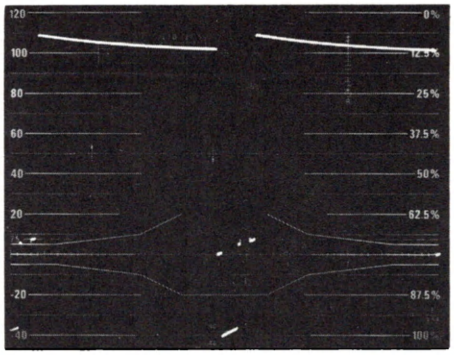


Figure 6. *Field Time Distortion observed with a 100 IRE Flat Field signal.*

This observation technique requires deleting the VIT Signal from a selected line in one field, while maintaining a VIT Signal of maximum energy content on the same line in the opposite field. The result will be a displayed difference in level in subsequent lines due to field time distortion. It may be considered as the residue of energy from the VIT Signal due to tilt. The signal used for Figure 7a is from the noise pedestal generated by a 147/147A when full line deletion at a 100 IRE level is selected. Figure 7b shows the same measurement made with the Composite waveform which, it must be noted, is less sensitive.

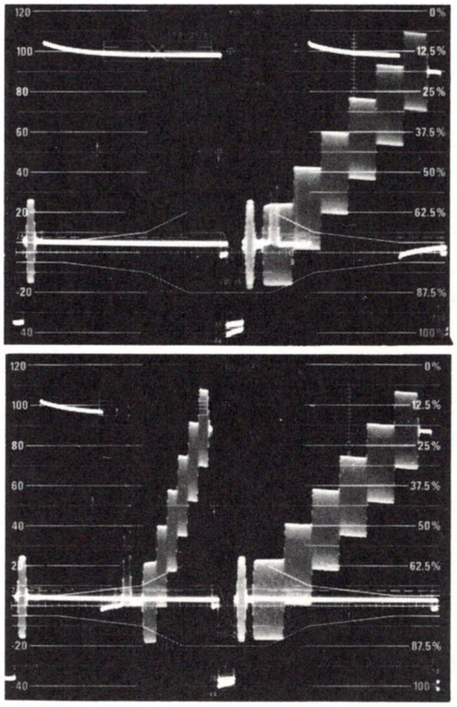
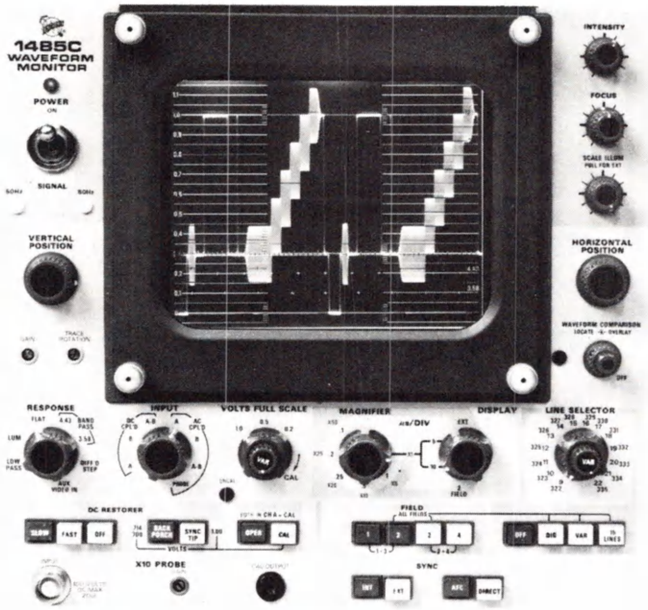


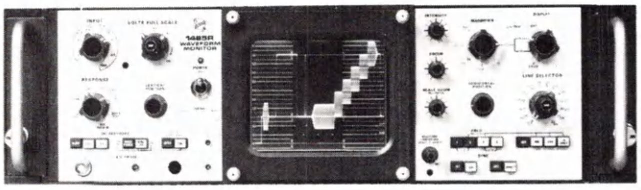
Figure 7. *Field Time Distortion observed from VIT Signals*
a. A full line 100 IRE pedestal from a 147/147A.
b. A Composite Test Signal.

This technique is obviously less sensitive, but will display enough field time distortion (field time tilt) to be a useful in-service measurement technique.

The versatile TEKTRONIX 1480-Series Waveform Monitor is ideally suited for routine operating, signal analysis or laboratory investigations. This application note deals with only one display mode, All Fields, for further application information contact the nearest Tektronix Field Office or representative



1485C



1485R

CHARACTERISTICS

VERTICAL DEFLECTION

Inputs—Input A and B are 75 Ω high impedance loop-through. Return loss is ≥40 dB from Dc to 5 MHz in a 75 Ω system. Aux Video Input is internally terminated in 75 Ω. Return loss is ≥34 dB from Dc to 5 MHz.

Scale Factor—A and B input calibrated— 1.0, 0.5, 0.2 volts full scale. Variable—Range for each scale factor at least +40% to −50%. Aux Video Input 1.5 dB gain.

Max. Input Voltage— 2 volts peak-to-peak (Ac coupled).

Frequency Response—Flat—Flat to 5 MHz ±0.5%; MHz to 10 MHz +0.5%, −5%. Low Pass—enuation ≥14 dB, 500 kHz and above. 3.58 Band Pass—Amplitude within ±1% of amplitude in Flat response position. Bandpass approximately 600 kH. 4.43 Band Pass—Amplitude within ±1% of amplitude in Flat response position. Bandpass approximately 600 kHz. IRE—Conforms to IRE Standard 23S-1 1958 amended.

DC Restorer—Keyed type, may be turned off. Clamping point: BACK PORCH/SYNC TIP. TIME CONSTANT: FAST reduces mains hum ≥26 dB, SLOW reduces mains hum <1 dB.

Calibrator—Amplitude selected by dc Restorer switch. Sync Tip — 1 volt ±0.2%, Back Porch — 714 mV or 700 mV ±0.5%.

Linear Waveform Distortion—Pulse/bar ratio ±1%. SHORT TIME: preshoot, overshoot, ringing ≤0.5% on 100 ns $\sin^2$ pulse. LINE TIME: TILT or rounding ≤0.5%. FIELD TIME: (AC coupled) ≤1%.

Non-Linear Distortion—Differential gain ≤0.5%.

HORIZONTAL DEFLECTION

Time-Base— 5 μsec and 10 μsec/Div, ±1% over center 10 divisions. 1μsec, 0.5 μsec, 0.25 μsec, 0.2 μsec and 0.1 μsec/Div ±2% over center 10 divisions. 2 FIELD — 12.7 division ±1%.

External Sync Input —Two loop-through high impedance, with ≥46 dB return loss in a 75 Ω system. Inputs are slaved to A and B input or to A external sync input only.

External Sync Input Requirements—400 mV to 2 volts composite video or 200 mV to 8 volts composite sync.

Field Selector—Positive selection of Field 1 or 2 in the NTSC system. Positive selection of 1, 2, 3, 4 or 1 & 3, 2 & 4 in the PAL systems.

ne Selector—Dig—Selects lines 9 to 22 NTSC, e 9/322 to line 22/335 PAL, line 9/272 to line 22/285 PAL-M. VAR—Approximately line 20 of the selected field to line 8 of the next related field. 15 lines—Identical to VAR, except 15 successive lines are displayed.

Sync—AFC: Horizontal frequency range is 15.75 kHz ±200 Hz. Max. jitter with respect to input sync 10 ns (30 ns with 4 volts rms hum plus −36 dB white noise). Direct: Horizontal frequency ≤20 kHz. Max. jitter with respect to input sync 12 ns (90 ns with 4 volts rms hum plus −36 dB white noise).

OUTPUTS

Line Strobe—TTL amplitude pulse. Pulse coincident with line or lines selected by VAR, 15 LINE or DIG modes of DISPLAY switch.

Picture Monitor—Output of incoming video with LINE STROBE added. Output impedance is 75 Ω. Output adjusted to unity with respect to A and B video input.

Aux Video—Output of incoming video. 75 Ω output impedance. Gain adjustable to unity with respect to A and B video input.

OTHER CHARACTERISTICS

RGB/YRGB Staircase Input—Approx. 12 volts for 12.7 divisions deflection. RGB sweep length internally selected for ⅓ normal sweep. YRGB sweep length internally selected for ¼ normal sweep length.

Mains Voltage—Ranges: 100 V ac, 110 V ac, 120 V ac, 200 V ac, 220 V ac, 240 V ac ±10%. Frequency: 48 Hz to 62 Hz, Max Power Consumption 75 W. At factory, 1480 preset for 110 V ac. 1481, 1482, 1485, preset for 220 V ac.

OPTION 1

10X Probe Channel—Scale Factor 1 V, 0.5 V, 0.2 V full screen with 10X attenuator probe. GAIN Range ±10%. Tilt ≤5% on 50 Hz square wave, High Frequency Response ±1%, 25 Hz to 5 MHz. ±3%, 5 MHz to 10 MHz. Referenced to 50 kHz. Input Resistance 1 MΩ, ±2%, not including probe. Input RC Product 20 μs, ±0.5%, not including probe. BNC connector accepts most TEKTRONIX probes. P6065A probe recommended.

10X Probe Calibrator—Output Voltage 1.000 V ±0.005 V or 0.995 to 1.005 V.

	Cabinet		Rackmount	
Dimensions	in	cm	in	cm
Height	8.25	21.0	5.25	13.3
Width	8.50	21.6	19.0	48.2
Depth	16.95	43.0	18.0	45.7
Weight	lb	kg	lb	kg
Net	21.5	9.8	24.6	11.2
Shipping	≈28.5	≈12.9	≈53.1	≈24.1

ORDERING INFORMATION

1480C NTSC Waveform Monitor

1480R NTSC Waveform Monitor

1481C PAL Waveform Monitor

1481R PAL Waveform Monitor

1482C PAL-M Waveform Monitor

1482R PAL-M Waveform Monitor

1485C PAL/NTSC Dual Standard Waveform Monitor

1485R PAL/NTSC Dual Standard Waveform Monitor

Option 01 1 megohm, 20 pf probe input (probe not included)
Suggested Probe
P6105A 10X Probe, 6-ft, Order 010-6065-13
9-ft, Order 010-6105-05

Option 02 With Carrying Case (Cabinet Version Only)

Option 03 With Blank CRT

Option 07 Slow Sweep

Option 08 Adds capability of recognizing four field sequence of SECAM (1481C, 1481R, 1485C, 1485R only)

OPTIONAL ACCESSORIES

Mounting Cradles—A cradle assembly, with associated bezel, allows the 1480C Waveform Monitor to be mounted alongside a 9-inch Conrac Picture Monitor in a standard 19-inch rack. A cradle and bezel are also available for mounting two 1480C's side-by-side.

For mounting 9-inch SNA-9 Picture Monitor (Requires 8¾ inches rack space)

Cradle Assembly	**014-0020-00**
Bezel, for mounting 1480C on operator's left	**014-0023-00**
Bezel, for mounting 1480C on operator's right	**014-0024-00**

For mounting two 1480C Waveform Monitors side-by-side (requires 8¾ inches rack space)

Cradle Assembly	**014-0020-00**
Bezel	**014-0022-00**

1480R Cradle Assembly—For mounting the 1480R in a WECO backless rack, **Order 426-0309-00**

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SPECIFICATION

This section covers the Electrical, Mechanical and Environmental specification of 1480-Series Waveform Monitors. Included here are the Electrical Specifications for Options 1, 4, 5, and 7. Options 2 and 3 require no change in the Electrical Specification and Option 6 has its own supplemental manual.

The electrical characteristics that follow can be verified using the Performance Check Procedure in Section 5.

ELECTRICAL CHARACTERISTICS

The electrical performance requirements given here can only be achieved over an operating ambient-temperature range of 0° C to +50° C, after a warm-up time of 20 minutes (necessary for operating temperatures at or near 0° C). In addition, the Performance Requirements are only valid if the instrument is calibrated in an ambient temperature between +20° C and +30° C, after a minimum warm-up time of 10 minutes.

Performance Requirements

Performance Requirements listed in this section assure accurate instrument performance. Where necessary they are specifically tested by the Performance Check Procedure found in Section 5. In many cases, it is not necessary to check each individual requirement, because assurance may be achieved in other ways.

In some areas, certain levels of performance have been designed into this instrument, and if not present, other broader Performance Requirements will not be met.

In a few cases, the equipment required is extremely expensive, not readily available, or the procedure necessary to verify performance is very exacting. Under these circumstances, lot sampling and repetitive testing is done at the factory to ensure that the instrument will continue to meet these Performance Requirements.

Table 4-1

VERTICAL SYSTEM

Characteristic	Performance Requirement	Supplemental Information
Input Impedance	75 ohms, nominal	Auxiliary Video Input
Vertical Ranges	VOLTS FULL SCALE 1.0 0.5 0.2	Display NTSC CCIR 140 IRE 100% 140 IRE 100% 140 IRE 100%
Vertical Accuracy VOLTS FULL SCALE 1.0 0.5 0.2	 ±7 mV ±15 mV ±7 mV	Any one range may be adjusted to unity. However, the accuracy of the others may not remain within the Performance Requirement.
Input Gain Ratios A to B	1 to 1 ±0.002 (0.998-1.002)	
AUXiliary VIDEO INput to INPUT A	1.5 dB ±0.3 dB	
INPUT A to AUXiliary VIDEO OUTput	1 to 1 ±0.005 (0.995-1.005)	Adjustable
INPUT A to PIX MONITOR OUTput	1 to 1 ±0.02 (0.98-1.02)	

Table 4-1 (cont)

Characteristic	Performance Requirement	Supplemental Information
Maximum Input Signal Ac coupled INPUT A and B	2.0 V, peak-to-peak at any average picture level 1.0 V, peak-to-peak at any average picture level, with both AUXiliary VIDEO OUTput and PIX MONITOR OUTput terminated.	Maximum dc component, 5V
Dc coupled INPUT A and B and AUXiliary VIDEO INput	±1.5 V, dc + peak ac	
Maximum voltage from Loop-Thru common terminal to chassis in "Floating Ground" mode	4 Vrms at mains frequency.	
Rejection of common-to-chassis in "Floating Ground" mode	At least 50 dB at mains frequency.	
VARiable VOLTS FULL SCALE Gain Range	0.5:1 to 1.4:1	
Common Mode Rejection Ratio INPUT A-B with 1 V peak-to-peak common mode signal. 60 Hz	At least 46 dB	Typically exceeds 46 dB from DC to 6 MHz
15 kHz (Luminance)	at least 46 dB	
4.43 or 3.58 MHz (Chrominance)	at least 34 dB	
Vertical Overscan 1 V peak-to-peak, PAL or NTSC 20T modulated Pulse Composite Video	less than 7 mV in baseline of chroma as positioned anywhere between sync tip and 100% white reference marks on graticule.	1.0, 0.5, or 0.2 V.F.S. settings, with VARiable in detent. (Less than 0.5% typical.
Frequency Response Flat 50 kHz-5 MHz	±1%	A, B, or AUXiliary video input 1.0 VFS only, VARiable in detent.
	±2%	0.5, 0.2 VFS, VARiable in detent.
	±3%	A or B video input to AUXiliary video output or PIX monitor output.

Table 4-1 (cont)

Characteristic	Performance Requirement	Supplemental Information
Frequency Response Flat (cont)		
5 MHz-8 MHz	+2%, −3% from 50 kHz reference.	A, B, and AUX In, VARiable in detent.
8 MHz-10 MHz	+2%, −6% from 50 kHz reference.	
10 MHz-18 MHz		+2%, −15% typical, 1.0 VFS
20 MHz		3 dB down typical, 1.0 VFS

NOTE

In the Performance Verification, Section 5, and the Adjustment Procedure, Section 8 of this manual, make all checks and adjustments of vertical bandpass to the Specification noted above.

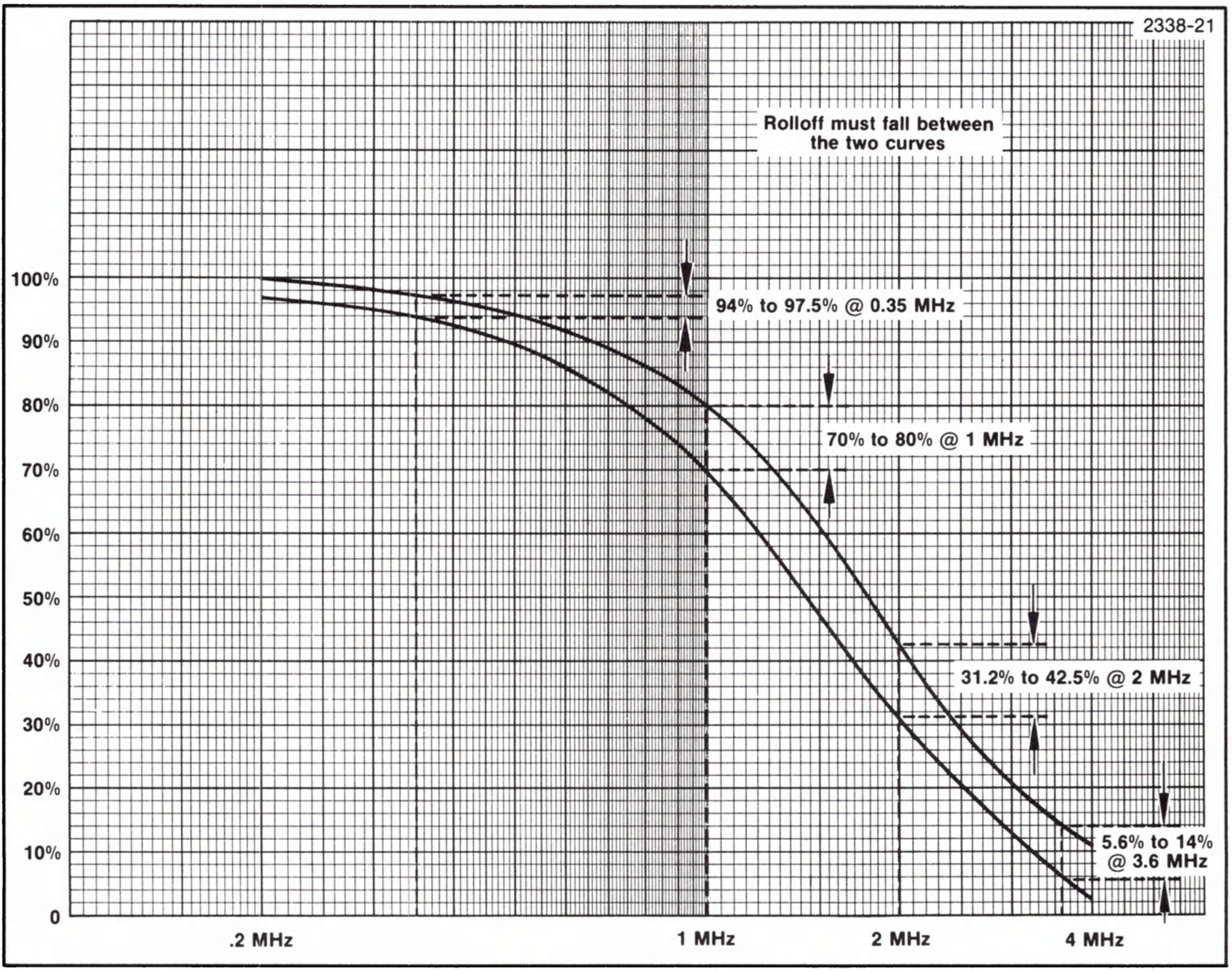


Fig. 4-1. IRE Standard 23S-1, 1958.

Table 4-1 (cont)

Characteristic	Performance Requirement	Supplemental Information
Filters IRE	Conforms to IRE Standard 23S-1, 1958, See Figure 4-1. At least 22 dB down at 4.43 MHz.	
Luminance	Less than 3 dB down at 1 MHz. At least 40 dB down at 4.43 MHz.	
Low Pass	At least 14 dB down at 500 kHz and above.	
Bandpass 3.58 MHz	±1% of flat at 3.58 MHz, −3 dB between 3.1 and 3.4 MHz and 3.8 & 4.0 MHz.	
4.43 MHz	±1% of flat at 4.43 MHz, −3 dB between 3.9 & 4.1 MHz and 4.7 & 4.9 MHz.	
Differentiated Steps (Diff'd Steps)	Less than 2 dB 0.4 MHz to 0.5 MHz. At least 20 dB 14 kHz and 2.0 MHz. At least 40 dB 3.58 MHz and 4.43 MHz.	Vertical gain increase approximately 5 times to compare staircase risers.
Linear Waveform Distortion Pulse Overshoot and Ringing NTSC or PAL T	Less than 1% of applied pulse amplitude.	1.0, 0.5, 0.2 VFS with variable in detent. (Typically within 0.5% on T pulse, and within 1.0% on T/2 pulse).
Pulse and Bar		
25 μs bar tilt	Less than 1% of applied bar amplitude.	
Field Squarewave Tilt	Less than 1% of applied squarewave amplitude.	
SIN^2 Pulse-to-Bar ratio NTSC or PAL 2T Pulse	1:1 ±1%	1.0, 0.5, 0.2 VFS with variable in detent.
NTSC T Pulse	1:1 ±1%	(2% and T-pulses are typically within 0.5%)
PAL T Pulse	.99:1 ±1%	
NTSC T/2 Pulse (62 ns HAD)	.98:1 ±2%	(1.0 VFS only, variable in detent for T/2 pulse) Pulse response is verified with sinewave magnitude response. Fig. 4-1 illustrates a typical 1480 Series sinewave response.

Table 4-1 (cont)

Characteristic	Performance Requirement	Supplemental Information
Non-Linear Waveform Distortion		
Differential gain		
displayed	Less than 0.5% any APL.	
AUXiliary VIDEO OUTput	Less than 0.25% any APL.	
Picture (PIX) MONITOR OUTput	Less than 0.25% any APL.	
Differential phase		
AUXiliary VIDEO OUTput	Less than 0.25° any APL.	
Picture (PIX) MONITOR	Less than 0.25° any APL.	
Maximum Output DC Voltage		
AUXiliary VIDEO OUTput	±0.5 V dc into 75 ohms	Input signal absent and line strobe present.
Picture (PIX) MONITOR OUTput	±0.5 V dc into 75 ohms	
DC Restorer		
Mains hum attenuation		
SLOW position	Less than 0.9 dB.	Change of back porch or sync tip level caused by hum.
FAST position	More than 26 dB.	
Shift caused by absence or presence of burst	Less 7 mV (CCIR) or 1 IRE (NTSC)	
Calibrator		
accuracy		
1.00 V	±0.2%	
0.714 V	±0.5%	NTSC
0.700 V	±0.5%	CCIR
Return Loss		
INPUT A or B (With 75 ohm termination.)	More than 40 dB, dc to 5 MHz.	Any front-panel control setting, instrument on or off.
AUXiliary VIDEO INput	More than 34 dB, dc to 5 MHz.	Instrument on only.
AUXiliary VIDEO OUTput	More than 34 dB, dc to 5 MHz.	Instrument on only.
Picture (PIX) MONITOR OUTput	More than 34 dB, dc to 5 MHz.	Instrument on only.
Luminance/Chrominance Gain Ratio		
1480, 1482, 50 kHz/3.48 MHz	1:1 ±1%	A, B, or AUX VID IN 1.0, 0.5, or 0.2 VFS (VAR in detent). (Adjusted to minimize luminance to chrominance gain error, typical performance is within 0.5%).
1481 50 kHz/4.43 MHz		
1485 50 kHz/4.0 MHz		

Table 4-2

X10 PROBE INPUT

(Option 1)

Characteristic	Performance Requirement	Supplemental Information
Input Resistance	1 Megohm ±2%	Not including probe.
Input RC Product	20 μs ±0.5%	Not including probe.
GAIN Range	±10%	Adjustable for 1 volt peak-to-peak display amplitude.
Gain	Unity ±3% (with GAIN adjusted for equivalent 1 volt peak-to-peak display).	
Frequency Response		Referenced to 50 kHz.
25 Hz to 5 MHz	±2%	
5 MHz to 10 MHz	+3%, −5%	
Tilt	Less than 5% on 50 Hz squarewave.	FAST DC RESTORER eliminates low-frequency tilt on a composite video signal.
Non-Linear Distortion		
differential gain	Less than 0.25%, any APL	
differential phase	Less than 0.25°, any APL	
Probe Calibrator		
waveform	Squarewave	
duty cycle	50%	
period	4 horizontal lines.	
output voltage	1.000 V ±0.5% (0.995 V to 1.005 V)	
output impedance	Approximately 950 ohms	

Table 4-3

SYNCHRONIZATION

(Standard Instruments)

Characteristic	Performance Requirement	Supplemental Information
SYNC Input		
INTernal	200 mV to 2 V peak-to-peak composite video.	Composite video applied to A or B VIDEO INPUT.
EXTernal		
composite video	400 mV to 2 V peak-to-peak composite video.	Composite video applied to EXTERNAL SYNC Input.
composite sync	200 mV to 8 V peak-to-peak composite sync.	Composite sync applied to EXTERNAL SYNC Input.
DIRECT SYNC		
Horizontal Frequency Range	Up to 20 kHz	Frequencies much below 15.75 kHz will not permit a normal TV display.

Table 4-3 (cont)

Characteristic	Performance Requirement	Supplement Information
Direct Sync (cont) Sync Jitter with composite video or composite sync	12 ns maximum jitter	With respect to input sync. With up to 4 V rms hum.
with variable APL (10 - 90%)	20 ns maximum jitter	With up to 4 V rms hum.
With variable APL (10 - 90%) + 36 dB white noise	90 ns maximum jitter	With up to 4 V rms hum.
AFC SYNC Horizontal Frequency Range	15.75 kHz ±200 Hz	
Lock-In Time	Less than 1 second	
Sync Jitter with composite video or composite sync	10 ns maximum jitter	With respect to input sync. With up to 4 V rms hum.
with variable APL (10 - 90%)	12 ns maximum jitter	With up to 4 V rms hum.
with variable APL (10 - 90%) + 36 dB white noise	30 ns maximum jitter	With up to 4 V rms hum.
Jitter with respect to white noise.		Jitter doubles with each 6 dB increase in white noise.
Noise Immunity DIRECT	Less than 250 ns jitter with 1 V composite video plus −26 dB white noise.	
AFC	Less than 90 ns jitter with 1 V composite video plus −26 dB white noise.	
Jitter from missing line sync-pulses.	Less than 15 ns per missing sync pulse.	Maximum of 10 consecutive line sync-pulses.
50/60 Hz Recognition		Automatic for dual-standard models.
Return Loss	Greater than −46 dB to 5 MHz.	

Table 4-4

SYNCHRONIZATION

(Option 4 & 5)

(Video Tape Recorder Tone Wheel Sync)

Characteristic	Performance Requirement	Supplemental Information
Tape Tone Wheel Sync NTSC (525/60) pulse polarity	Negative	All Performance Requirements listed in Table 4-3 apply.
repetition rate	240 Hz	
pulse period	4.166 ms	
pulse width	300 μs	
pulse amplitude	4 V to 15 V	
PAL (625/50) pulse polarity	Negative	
repetition rate	250 Hz	
pulse period	4.0 ms	
pulse width	300 μs	
pulse amplitude	4 V to 15 V	

Table 4-5

SYNCHRONIZATION

(Option 7)

(Slow Sweep)

Characteristic	Performance Requirement	Supplemental Information
SLOW SWEEP Triggering Signal	APL change from 10% or less to 90%	Front-panel selectable for either + or − level change.
Sensitivity	400 mV to 2V peak-to-peak composite video with APL change.	
Rate	0.2 Hz or more.	Free runs at rates less than 0.2 Hz or with no triggering signal.
Input		Internal or External

Table 4-5 (cont)

Characteristic	Performance Requirement	Supplemental Information
50/60 Hertz Squarewave Triggering		
Frequency Range	From less than 50 Hz to more than 60 Hz.	
Signal		A 50 to 60 Hz squarewave with no field-sync and filtered line-sync.
Sensitivity	400 mV peak-to-peak min. to 3 V peak-to-peak max.	
Input Impedance		Approximately 10 kilohm ac coupled
Input Acquisition		Rear-panel AUXiliary SYNC loop-thru input connector.
Actuation		Simultaneous use of the INTernal and EXTernal SYNC switches.

Table 4-6

HORIZONTAL SYSTEM

Characteristic	Performance Requirement	Supplemental Information
Sweep Timing Accuracy		
5 μs/DIVision	±2% (center 10 divisions)	
10 μs/DIVision	±2% (center 10 divisions)	
2 FIELD		Proportional to the line-rate sweeps (5 and 10 μs/division).
Linearity		
5 μs/DIVision	±1%	
10 μS/DIVision	±1%	
2 FIELD	±0.5 division	
SLOW SWEEP (Option 7)	±5% of full-screen over the length of the sweep.	
Magnified Sweep Timing Accuracy	Applies to center 10 div. of unmagnified sweep and excludes first 2 div. of magnified display.	
X5 (1 μs/DIV.)	±1%	
X10 (0.5 μs/DIV.)	±2%	
X20 (0.25 μs/DIV.)	±3%	
X25 (0.2 μs/DIV.)	±3%	
X50 (0.1 μs/DIV.)	±3%	
Linearity	Applies to center 10 div. of unmagnified sweep and excludes first 2 div. of magnified display.	Calibrated at 1 μs/DIV.
X5 (1 μs/DIV.)	±1 minor div (≤2%)	
X10 (0.5 μs/DIV.)	±1 minor div (≤2%)	
X20 (0.25 μs/DIV.)	±1 minor div (≤2%)	
X25 (0.2 μs/DIV.)	±1 minor div (≤2%)	
X50 (0.1 μs/DIV.)	±1 minor div (≤2%)	

Table 4-6 (cont)

Characteristic	Performance Requirement	Supplemental Information
VARiable MAGNIFIER (1481, 1482 and 1485 only)		
Range	At least ±20%	
UNCALibrated Indicator		Front-panel lamp indicates when the control is in a position other than detent.
SLOW SWEEP (Option 7)		
Duration	4 to 12 seconds, variable with front-panel control.	
Indicator		Front-panel indicator lit when slow sweep is operating but not actually running.
RGB/YRGB		
Staircase Input	Approximately 12 volts for 12.7 divisions of deflection. DC signal levels, plus peak ac, not to exceed −12 to +12 volts. maximum ac signal level is 12 volts peak-to-peak.	Staircase is positive-going.
Sweep length		
RGB		
2 FIELD	27% to 33% of normal sweep.	
10 μs/DIV.	27% to 33% of normal sweep.	
5 μs/DIV.	27% to 33% of normal sweep.	
YRGB		
2 FIELD	20% to 25% of normal sweep.	
10 μs/DIV.	20% to 25% of normal sweep.	
5 μs/DIV.	20% to 25% of normal sweep.	
Sweep Repetition Rate		
2 FIELD	Field rate of applied video.	
5 or 10 μs/DIVision	Line rate of applied video.	
EXTERNAL HORIZONTAL INput		
Sensitivity	5 volts = 10 division	Dc-coupled, positive-going from 0V. Crt is unblanked with no provision for external blanking or unblanking.
Linearity	±1%	
Input Impedance		Approximately 10 kilohms.

Table 4-6 (cont)

Characteristic	Performance Requirement	Supplemental Information
WAVEFORM COMPARISON		
LOCATE		
Range	Will place location index anywhere on 5 μs/DIVision or 10 μs/DIVision unmagnified sweep.	Range reduced by one-half with magnified 10 μs/DIVision sweep.
OVERLAY		
Range	Will overlay the selected portion of sweep, marked by the locate index, on portion of the sweep preceding the index.	5 μs/DIVision or 10 μs/DIVision unmagnified.
LINE STROBE OUTPUT	Incidence and duration dictated by line selection.	TTL-amplitude.

Line Selection

Variable (VAR) selects a single line from approximately line 20 of the selected field (see Field Selection) through the next field and vertical interval to approximately line 8. Any line intensified in 2 FIELD will be the one displayed in 5 μs/DIVision, or the first line displayed in 10 μs/DIVision sweep speeds.

15 LINES operation covers the same range, but intensifies a block of 15 consecutive lines. In 2 FIELD display, this intensification shows up as a block of lines. At 10 μs/DIVision, a two-line display of increased brightness, starting with the first intensified line (in 2 FIELD) will be seen. At 5 μs/DIVision, a single brightened line will be seen, again beginning with the first intensified line. See Figure 4-2.

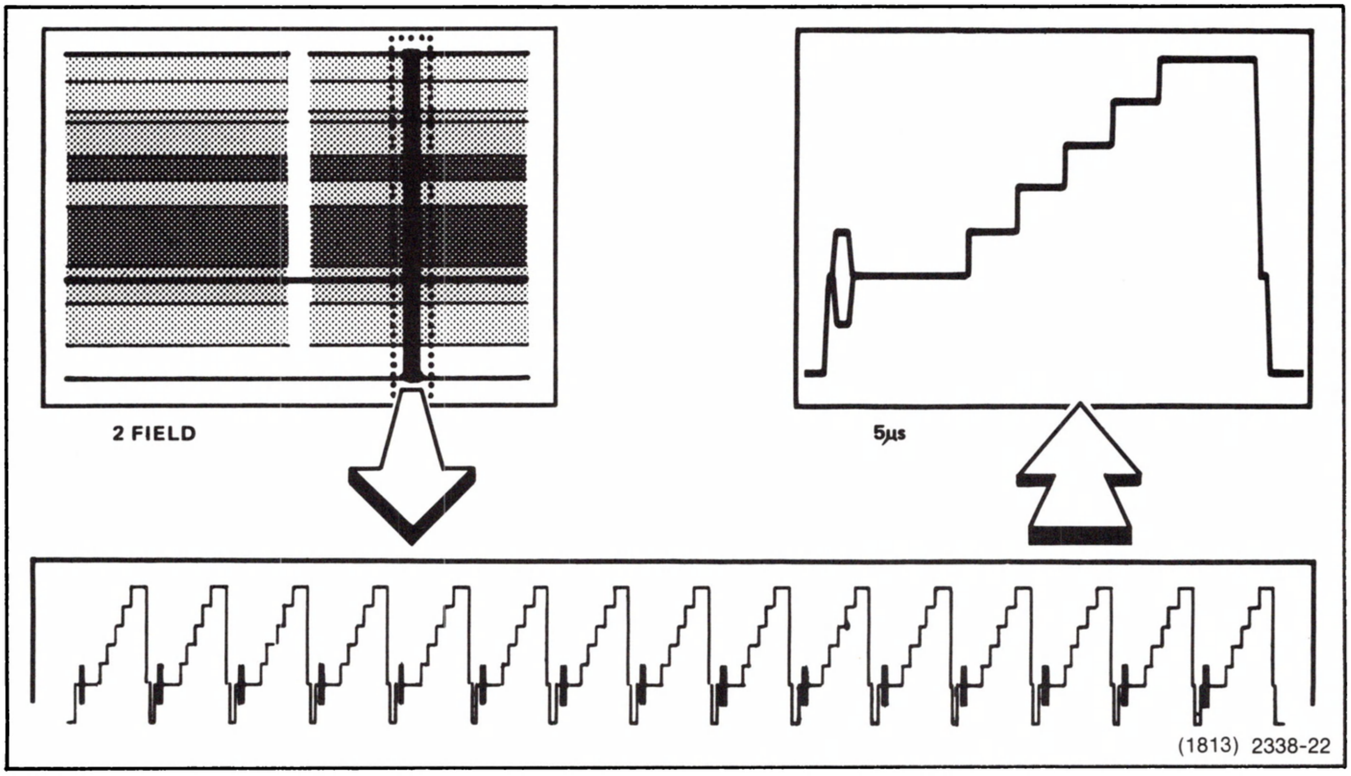


Fig. 4-2. 15-Line display mode.

Digital (DIG) selects any one of 13 lines, the 9th through the 22nd, of the selected field (this includes lines 322 through 335 PAL and 272 through 285 PAL-M). In 2 FIELD displays, the digitally-selected line is intensified. In 10 μs/DIVision, the first line displayed is the digitally-selected one.

Field Selection

The FIELD Selector is a set of four push-buttons providing positive field-selection. In the PAL systems where four distinct fields exist (Bruch Sequence), it is possible to select each field individually as well as the odd and even field-pairs. In NTSC, the odd and even fields are all that are identifiable.

The display starts at about line 20 of the selected field and goes on through the next full field, terminating at about line 8 of the next complimentary field. (For example, starts on an even field and ends at the beginning of the next even field.)

ALL FIELDS provides a method of time-overlaying the even and odd fields. All line selection modes are functional; however, for 15 LINES and VARiable, the VARiable LINE SELECTOR must be in the first field of a normal 2 FIELD display. ALL FIELDS display is selected by simultaneously pushing the center-two FIELD Selector pushbuttons.

Table 4-7

POWER SOURCE

Characteristic	Performance Requirement	Supplemental Information
Mains Voltage		
Ranges	100 Vac ±10%	
	110 Vac ±10%	
	120 Vac ±10%	
	200 Vac ±10%	
	220 Vac ±10%	
	240 Vac ±10%	
Frequency	48 to 62 Hertz	
Crest Factor		At least 1.3
Maximum Power Consumption	75 watts	

Table 4-8

ENVIRONMENTAL CHARACTERISTICS

Characteristic	Performance Requirement	Supplemental Information
Temperature		
Operating	0° C to 50° C	
Storage	−40° C to +65° C	
Altitude		
Operating	To 15,000 feet	
Storage	To 50,000 feet	

Table 4-9

MECHANICAL CHARACTERISTICS

Characteristics	English Units	Metric Units
Cabinet Model		
Length	16.95 inches	43 cm
Width	8.50 inches	21.6 cm
Height	8.25 inches	21 cm
Net Weight	21 lb. 8 oz.	9.81 kg
Domestic Shipping Weight	28 lb. 8 oz.	12.9 kg
Export Shipping Weight	41 lb. 8 oz.	18.8 kg
Rackmount Model		
Length	18 inches	45.7 cm
Width	19 inches	48.3 cm
Height	5.25 inches	13.3 cm
Net Weight	24 lb. 9 oz.	11.2 kg
Domestic Shipping Weight	53 lb. 2 oz.	24.1 kg
Export Shipping Weight	75 lb. 2 oz.	34.1 kg

PERFORMANCE VERIFICATION PROCEDURE

This procedure verifies the Performance Requirements of the Electrical Characteristics found in Section 4. Steps at the end of the procedure are for the various operating options; i.e., Option 1, X10 Probe (these options may or may not be present in the instrument under test), allows for a single verification procedure for all models.

If the operation of this instrument is found to be outside the performance requirements, it should be referred to a qualified service technician for re-adjustment.

1480-Series Waveform Monitors have two basic graticule scales. One is used in the NTSC countries, and is referred to in this procedure as the NTSC graticule. The other, scaled for use with PAL standards, is identified as the CCIR graticule. The horizontal time-scale is the same for both because the 1480-Series time-base is in microseconds (μs) rather than increments of line time. The major difference lies in the vertical scales, 0 to 1 volt for the CCIR graticule and −40 to +100 IRE for the NTSC graticule. Where amplitude measurements are made in this procedure, the results are given in both mV and IRE.

Through most of this procedure, the instrument is operating in a 75 Ω impedance system. A 75 Ω end-line termination should be used on the open side of the loop-thru connector pair when termination is required.

Front- and rear-panel control and connector names on the 1480-Series instrument under test are capitalized; for example, VOLTS FULL SCALE. Control and connector names on test equipment have only the first letter capitalized; for example, Time/Div.

TEST EQUIPMENT REQUIRED

The test equipment listed here was used in preparing this procedure. The measurement capabilities described are the minimum required to verify instrument performance. Each piece of test equipment is assumed to be operating within its stated specifications. If alternative equipment is used, it must meet or exceed these requirements.

Some additional test equipment is required to check the performance of the options for the 1480. This equipment is listed at the beginning of the optional step to be performed. If this instrument contains options other than 2, 3, or 6, be sure to check the Additional Equipment Required list for that option.

1. Video Signal Source

Capable of generating color bars, composite sync, and modulated staircase test signals.

Standard	Recommended Instrument
NTSC	Tektronix 140
PAL	Tektronix 145
PAL-M	Tektronix 145-M

2. Digital Voltmeter

Accurate within 0.1% for dc volts from −4500 to +200 V. Example: TEKTRONIX DM 501 with a high-voltage probe (Tektronix Part Number 010-0277-00). (See item 6.)

3. Leveled Sine-Wave Generator

Capable of amplitudes from 0.2 volt peak-to-peak to 5 volts peak-to-peak, frequency range from 50 kHz (reference) to 10 MHz. Example: a TEKTRONIX SG 503. (See item 6.)

4. Time-Mark Generator

Capable of generating time-marks at intervals from 100 ns to 10 μs, with accuracy adjustable to within 1 part in 10^7. A TEKTRONIX 184 (if available) or TEKTRONIX TG 501 (see NOTE following Test Equipment Required list).

5. Ramp Generator

Capable of generating a 5-volt ramp. Example: a TEKTRONIX FG 501. (See item 6.)

6. Power Module

For powering and housing TEKTRONIX DM 501, TG 501, FG 501, and SG 503 units. (Required if using these units.) TEKTRONIX TM 504.

7. Test Oscilloscope

Dual Time-Base. Range from 50 ns/Div to 5 s/Div with provisions for a delaying sweep and television triggering.

Differential Comparator. Bandwidth, dc to 30 MHz; minimum deflection factor, 1 mV/Div; two channels capable of differential operation.

Dual-Trace Amplifier. Vertical amplifier independent of the Differential Comparator. Bandwidth dc to 30 MHz; minimum deflection factor 5 mV/Div.

Example: a TEKTRONIX 7603 with 7B53A Option 5 Dual Time-Base, 7A13 Differential Comparator, and 7A18 Dual-Trace Amplifier.

8. Return Loss Bridge
Tektronix Part Number 015-0149-00.

9. Television Test Signal Generator
Capable of generating 3-step and 4-step RGB/YRGB signals. Example: a TEKTRONIX 067-0601-00 Television Test Signal Generator.

10. 75 Ω Coaxial Cable
42 inches long, four each. Tektronix Part Number 012-0074-00.

11. 75 Ω End-Line Termination
Four each, Tektronix Part Number 011-0102-00.

12. 75 Ω Feed-Through Termination
Two each, matched within 0.2%. Supplied as accessories with the Return Loss Bridge (item 8). Tektronix Part Number 011-0103-00.

13. 75 Ω Feed-Through Termination
Tektronix Part Number 011-0103-02. Two each.

14. 50 Ω to 75 Ω Minimum Loss Attenuator
Tektronix Part Number 011-0057-00.

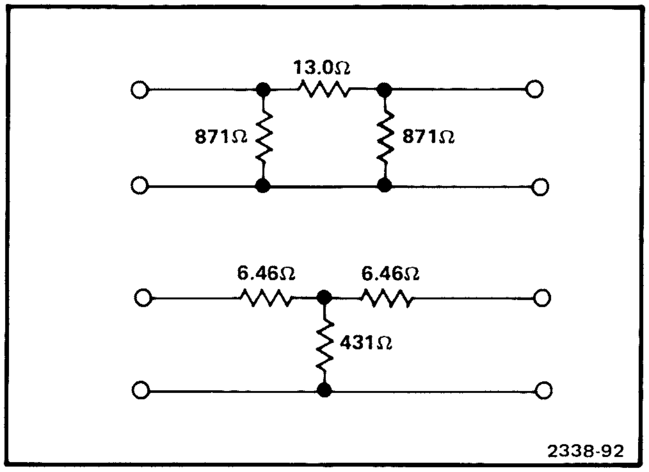
15. Attenuators
2X—Tektronix Part Number 011-0069-02.
5X—Tektronix Part Number 011-0060-02.
10X—Tektronix Part Number 011-0059-02.

16. Bnc Cable Tee-Connector
Tektronix Part Number 067-0525-01.

17. P6101 1X Probe
Tektronix Part Number 010-6101-01.

18. P6105 10X Probe
Tektronix Part Number 010-6105-01.

19. 1.5-dB Attenuator
Must be constructed by customer as shown below:



75 Ω 1.5 dB Attenuators

Note

For stable synchronization of the display when checking or adjusting horizontal timing of the sweep, a negative-going triggering signal must be supplied.

The markers and triggers from the TEKTRONIX TG 501 Time-Mark Generator are positive-going. Inversion of the markers or trigger output is easily accomplished, using test equipment that is normally required for other parts of the Performance Verification Procedure and the Adjustment Procedure.

The positive-going markers (or triggers) from the TG 501 can be coupled through the −Input on the Differential Comparator, where inversion occurs. The resulting negative-going signal is available on the rear panel of the 7603 Oscilloscope at the Vert Sig Out connector. The output amplitude depends directly upon the number of divisions of vertical deflection on the screen of the 7603 Oscilloscope. The 7A13 Differential Comparator unit is capable of handling several screen diameters of signal without excessive distortion, so the output signal is not limited by the 8-division graticule height.

PROCEDURE

1. Check Astigmatism

a. Connect the video signal source to the 1480-Series Video INPUT A Connector and terminate the loop-through connector into 75 Ω. See Figure 5-1.

b. Set the INTENSITY control to about "2 o'clock" and adjust the front-panel FOCUS control for a sharp, well-defined display.

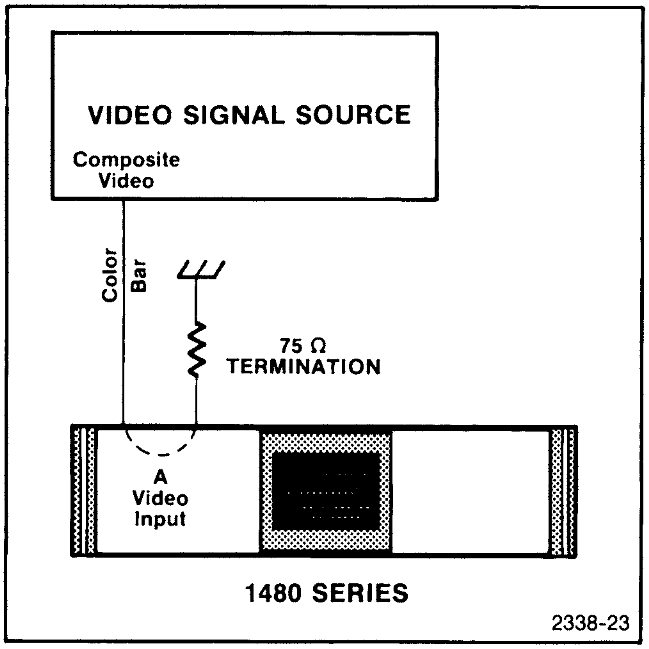


Fig. 5-1. Initial connections for 1480-Series performance check.

2. Check Magnified Intensification and Focus Tracking

a. Alternately press the LINE SELECTOR OFF and DIG pushbuttons, without readjusting FOCUS or INTENSITY. Check that the display maintains its definition and brightness.

b. Press the LINE SELECTOR OFF pushbutton.

c. Rotate the MAGNIFIER switch throughout its range and check that the display maintains its brightness over the MAGNIFIER range.

3. Check Geometry and Trace Rotation

a. Set the INPUT selector to B, DC CPL'D and position the trace to the graticule center-line. (0.5 V or 40 IRE).

b. Check that the trace is level with the center graticule line. If not, adjust TRACE ROTATION so that the trace is level with the center graticule line.

c. Check that the trace is approximately level with the top and bottom graticule lines.

4. Check Y Axis Alignment

a. Change the INPUT selector to A, DC CPL'D and set the VOLTS FULL SCALE selector to 0.2. Vertically position the display so that only the rising and falling portions of the display are visible.

b. Use the HORIZONTAL POSITION control to position the vertical lines across the crt screen. Check that the vertical lines are perpendicular to the bottom graticule line.

5. Check Vertical Gain Out (A VIDEO INPUT to AUX VIDEO OUT)

a. Connect the video signal source and test oscilloscope as shown in Fig. 5-2.

b. Set the test oscilloscope to 20 mV/Div, differential input with ac coupling. Shut off the test generator chrominance.

c. Check the display on the test oscilloscope for 5 mV or less amplitude, excluding transitional spikes.

6. Check PIX MONITOR OUT Gain

a. Change the output cable from the AUX VIDEO OUT connector to the PIX MONITOR OUT connector.

b. Check for a display amplitude of 20 mV or less, excluding transitional spikes.

7. Set Front-Panel Gain Adjustment

a. Press the DC RESTORER, SYNC TIP, and CAL pushbuttons.

b. Check for 1-volt equivalent display height.

c. Adjust GAIN control, if necessary, for 1-volt equivalent display height.

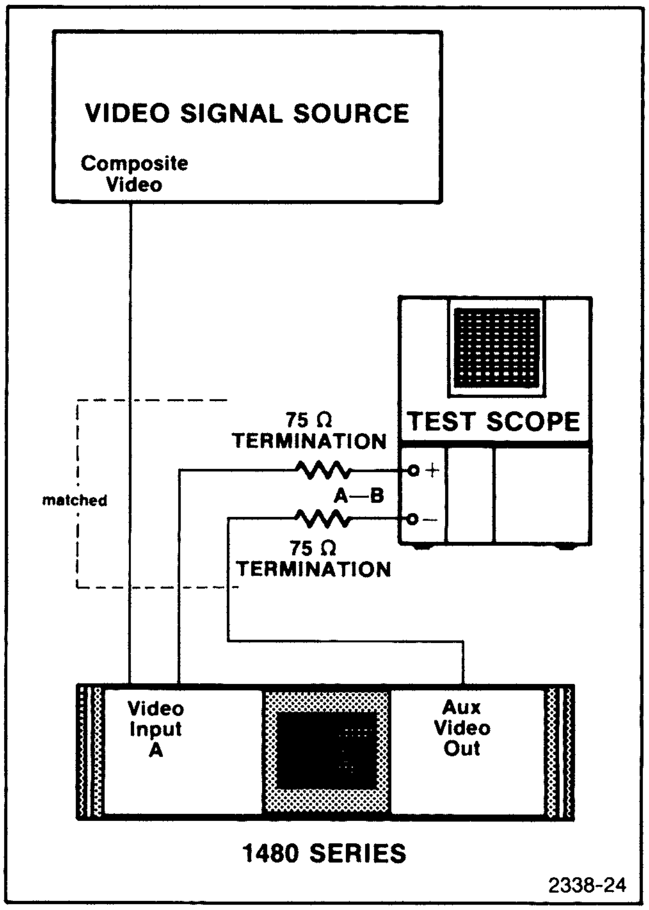


Fig. 5-2. Setup for 1480-Series Gain Measurement.

8. Check A to B Input Gain Ratio

a. Set the test signal generator Variable APL or % Peak White to 100 and the 1480-Series VOLTS FULL SCALE selector to 1.0.

b. Check display amplitude, 1.0 volt or 140 IRE from sync tip to peak white, ±0.42 IRE (NTSC) or ±3 mV (CCIR). Note exact amplitude.

c. Change the video input cable to the 1480-Series VIDEO INPUT B connector and change the 75 ohm termination to the VIDEO INPUT B loop-thru connector. Change the 1480-Series INPUT switch to B, DC CPL'D.

d. Check display amplitude and compare to that noted on the A INPUT, A = B ±2 mV (CCIR) or 0.28 IRE (NTSC).

9. Check VARIABLE VOLTS FULL SCALE Range

a. Check the amplitude of the sync pulse (40 IRE NTSC or 300 mV CCIR).

b. Rotate the VARiable VOLTS FULL SCALE control just out of detent and check sync pulse amplitude, 56 IRE (NTSC) or 420 mV (CCIR), or more.

c. Rotate the VARiable VOLTS FULL SCALE control fully counterclockwise and check the sync pulse amplitude for minimum amplitude, 20 IRE (NTSC) or 150 mV (CCIR) or less.

d. Return the VARiable VOLTS FULL SCALE control to its detented position.

10. Check AUX VIDEO IN Response Change

a. Connect a color bar test signal from the video signal source to the 1480-Series VIDEO INPUT A connector. Connect the VIDEO INPUT A loop-thru connector to the AUX VIDEO IN connector. Do not terminate. Set the RESPONSE switch to FLAT, and the DISPLAY switch to 5 μs/div. Note the amplitude difference between the tops of the yellow and cyan bars. See Fig. 5-3, Color Bar.

b. Set the RESPONSE switch to AUX VIDEO IN.

c. Check the amplitude difference between the tops of the yellow and cyan bars; it should be the same as that noted earlier.

d. Set the VOLTS FULL SCALE selector to 0.2. Position the tops of the yellow and cyan bars to the top of the graticule, then to the bottom of the graticule.

e. Check for a difference of 7.5 mV or less between the yellow and cyan bars.

f. Set the VOLTS FULL SCALE selector to 1.0.

g. Check the amplitude difference between the tops of the yellow and cyan bars; it should be the same as that noted at the beginning of this step.

h. Connect the leveled sinewave generator output through a 50 Ω to 75 Ω Minimum Loss Attenuator, to the AUX VIDEO IN connector. Set the leveled sinewave generator for a frequency of 50 kHz and an output amplitude of 1 volt (140 IRE for NTSC). Do not change the leveled sinewave generator amplitude for the remainder of this step.

i. Change the 1480-Series VOLTS FULL SCALE selector to 0.5 and vertically position the display so that the top of the display is at the 1.0 V (or 100 IRE) line. Note: because the vertical sensitivity is doubled, the graticule scale is now halved, making the major vertical divisions 50 mV or 5 IRE. Minor divisions, where they occur, are now 5 mV or 1 IRE.

j. Check auxiliary video input response according to Table 5-1A (0.5 VOLTS FULL SCALE).

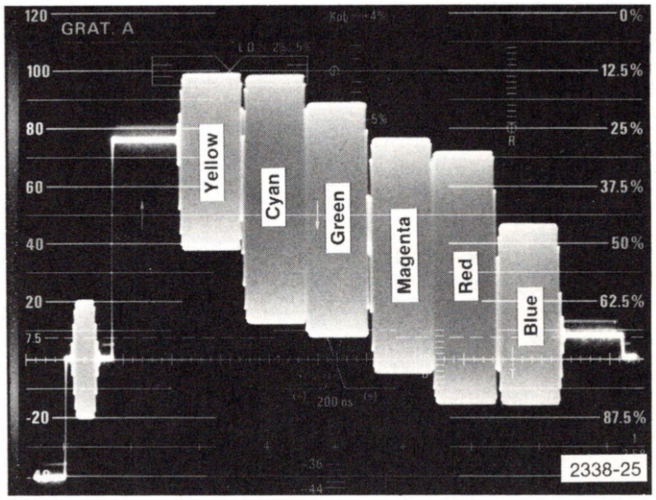


Fig. 5-3. NTSC Color Bar Signal (Color Bars are in identical location for PAL signal.)

Table 5-1A

VOLTS FULL SCALE	Leveled Sine-wave Generator	Amplitude	Limit
0.5	50 kHz	1 volt	Set as reference at 1 volt.
0.5	5 MHz	1 volt (Ref. 50 kHz)	±2%, 20 mV or 2.8 IRE
0.5	8 MHz	1 volt (Ref. 50 kHz)	+2%, −3% from 50 kHz reference
0.5	10 MHz	1 volt (Ref. 50 kHz)	+2%, −5% from 50 kHz reference

Table 5-1B

VOLTS FULL SCALE	Leveled Sine-wave Generator	Amplitude	Limit
0.2	50 kHz	1 volt	Set as reference at 1 volt.
0.2	5 MHz	1 volt (Ref. 50 kHz)	±2%, 20 mV or 2.8 IRE
0.2	8 MHz	1 volt (Ref. 50 kHz)	+2%, −3%
0.2	10 MHz	1 volt (Ref. 50 kHz)	+2%, −5%

k. Return the leveled sine-wave generator frequency to 50 kHz. Change the 1480-Series VOLTS FULL SCALE selector to 1.0 and check for 1 volt of display amplitude. Do not change the leveled sine-wave generator amplitude for the remainder of this step.

l. Set the 1480-Series VOLTS FULL SCALE selector to 0.2 and vertically position the top of the display to the 1.0 V (or 100 IRE) line. Note: because the vertical sensitivity has been increased by a factor of five, the graticule scale reduces by a factor of five. Each major division is now 20 mV or 2 IRE instead of 100 mV or 10 IRE. Minor divisions are now 2 mV or 0.4 IRE.

m. Check auxiliary video input response according to Table 5-1B (0.2 VOLTS FULL SCALE).

11. Check Common -Mode Rejection

a. Connect the video signal source composite video output through a 75 Ω feed-through termination and the bnc cable tee connector to the A and B VIDEO INPUTS. Do not terminate the loop-through connectors.

b. Set the video signal source for a 90% APL (average picture level) modulated pedestal signal.

c. Set the DISPLAY to 5 μs/Div, INPUT to A−B, DC CPL'D and VOLTS FULL SCALE to 0.2.

d. Check display amplitude for 70 mV or less.

12. Check A and B Frequency Response

a. Connect the leveled sine-wave generator output through the 50 Ω to 75 Ω minimum loss attenuator, a 75 Ω feed-thru termination, and the bnc cable tee connector to the A and B VIDEO INPUTS. Do not terminate the loop-thru connectors.

b. Set the leveled sine-wave generator frequency to 50 kHz and amplitude for 140 IRE units, or 1-volt display height.

c. Set the leveled sine-wave generator frequency to 5 MHz.

d. Check for a display height of 140 IRE or 1 V ±2%.

e. Set INPUT to B, AC CPL'D.

f. Check for a display height of 140 IRE or 1 V ±2%.

g. Check frequency response for A and B VIDEO INPUTS as in Table 5-2.

Table 5-2

<table>
<tr><th>Frequency</th><th colspan="3">Limit</th></tr>
<tr><td>0.05 MHz</td><td colspan="3">Reference—140 IRE NTSC,
1 V equivalent display height
PAL</td></tr>
<tr><td>0.44 MHz</td><td>1 Volt
140 IRE</td><td>±2%</td><td>20 mV
2.8 IRE</td></tr>
</table>

13. Check AUX VIDEO OUT Response

a. Connect the video signal source composite video output through a 75 Ω feed-thru termination and the bnc cable tee connector to the A and B VIDEO INPUTS. Do not terminate the inputs.

b. Connect the AUX VIDEO OUT through the 1.5 dB attenuator to the AUX VIDEO IN connector.

c. Set the video signal source for a color bar test signal output.

d. With the RESPONSE switch in the FLAT position, generally note the amplitude of the chrominance portion of the display, and specifically note the amplitude difference between the yellow and cyan bars; note also the peak-to-peak amplitude of the composite signal.

e. Set the RESPONSE switch to AUX VIDEO IN.

f. Check the peak-to-peak display amplitude of the composite signal; it should be within 5% of that noted previously.

g. Check the chrominance amplitude and the amplitude difference between the yellow and cyan bars; it should be within 0.5% of that noted previously.

14. Check IRE Filter (NTSC only)

a. Connect an NTSC video signal source to the 1480-Series VIDEO INPUT, A connector and terminate the loop-thru connector in 75 Ω.

b. Set the RESPONSE switch to IRE, and the INPUT switch to A, AC CPL'D.

c. Set the video signal source for a five-step staircase, modulated with 20 IRE of subcarrier step.

d. Check that the luminance portions of the signals have no preshoot, overshoot, or ringing. Chrominance on the staircase should be 2.9 IRE or less.

15. Check LOW PASS Filter

a. Press the CAL and DC RESTORE SYNC TIP pushbuttons.

b. Set the RESPONSE switch to LOW PASS.

c. Check the corner of the leading edge of the calibrator square-wave for 0.5% (5 mV or 0.7 IRE) or less overshoot or ringing.

16. Check DIFF'D STEP Filter

a. Connect the video signal source composite video output to the 1480-Series VIDEO INPUT A connector and terminate the loop-thru connector in 75 Ω.

b. Set the RESPONSE switch to DIFF'D STEP and press the OPER pushbutton.

c. Set the video signal source for a five-step staircase, modulated with 140 mV or 20 IRE of subcarrier.

d. Check the amplitude of the differential-step risers, 5X normal. The differentiated pulses should have 1% or less preshoot, overshoot and ringing.

e. Disconnect the composite video and connect the subcarrier from the video signal source to the 1480-Series instrument.

f. Check that the displayed subcarrier is 20 mV (or 2.8 IRE) or less.

17. Check 3.58 MHz Bandpass Filter (if used)

a. Connect the video signal source color bar signal to the 1480-Series VIDEO INPUT A connector and terminate the loop-thru connector in 75 Ω.

b. Set the VOLTS FULL SCALE AND VOLTS FULL SCALE VAR so that the red bar is 100 IRE in amplitude. See Fig. 5-4.

c. Set RESPONSE to 3.58 BANDPASS.

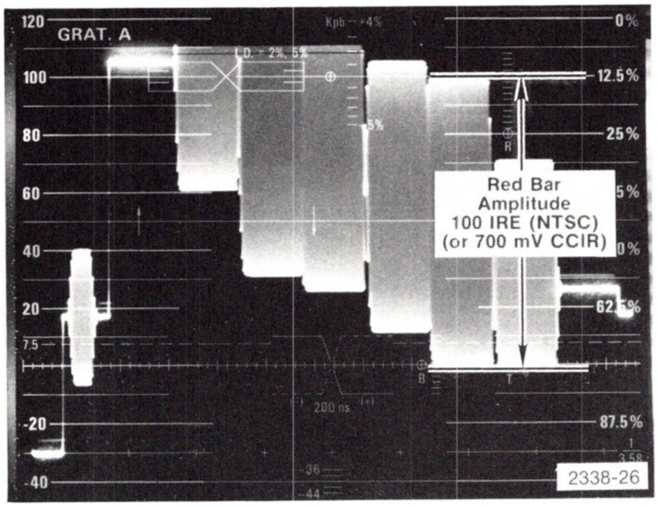


Fig. 5-4. Red Color Bar with amplitude increased to 100 IRE (NTSC).

d. Check that the red bar is within 1% of the amplitude set earlier in this step. The tops of the bars should be flat, and rise- and fall-time of the color burst should be nearly identical.

e. Disconnect the composite video signal and connect the leveled sine-wave generator to the 1480-Series instrument. Set the leveled sine-wave generator frequency to 3.58 MHz and amplitude for a convenient reference (100 IRE).

f. Check that the display amplitude is 3 dB from the reference (100 IRE at 3.58 MHz) at 3.1 to 3.4 MHz and 3.8 to 4.0 MHz.

18. Check 4.43 MHz Bandpass Filter (if used)

a. Connect the video signal source to the VIDEO INPUT A connector and terminate the loop-thru connector in 75 Ω. Set the video signal source for a standard color bar test signal.

b. Set the 1480-Series VOLTS FULL SCALE selector and the VOLTS FULL SCALE VAR so that the red bar is 700 mV in amplitude.

c. Set the RESPONSE selector to 4.43 BANDPASS.

d. Check that the red bar is within 1% of the amplitude set earlier in this step. The tops of the bars should be flat, and the rise- and fall-time of the color burst should be nearly identical.

e. Disconnect the composite video signal and connect the leveled sine-wave generator signal to the 1480-Series instrument.

f. Set the leveled sine-wave generator frequency for 4.43 MHz and amplitude for a convenient reference (1 Volt).

g. Check that the display amplitude is 3 dB from the reference (700 mV at 4.43 MHz) at 3.9 to 4.1 MHz and 4.7 to 4.9 MHz.

19. Check Calibrator Accuracy

a. Press the CAL and DC RESTORER SYNC TIP pushbuttons.

b. Connect the AUX VIDEO OUT through 75 Ω termination to the test oscilloscope differential comparator + input.

c. Set the test oscilloscope Time/Div to 50 μs, Volts/Div to 50 mV, and for comparison voltage operation.

d. Connect the test oscilloscope differential comparator Vc out to the digital voltmeter input. Connect the other digital voltmeter lead to the test oscilloscope ground.

e. Set the test oscilloscope differential comparator Vc to 0000. Vertically position the bottom of the square-wave to graticule center. Note the digital voltmeter reading.

f. Rotate the differential comparator Fine Comparison Voltage control to set the top of the square-wave to graticule center. Check that the amplitude of the square-wave is 1 V ±2 mV.

g. Press the DC RESTORER BACK PORCH pushbutton.

h. Check for a square-wave amplitude of 700 mV ±0.5% (3.5 mV) for models with CCIR internal graticule scale, and 100 IRE ±0.5% (0.5 IRE) in NTSC models.

20. Check GAIN

a. Press the DC RESTORER SYNC TIP pushbutton.

b. Check that the 1480-Series display is 1 volt ±0.2%.

c. Adjust the front-panel GAIN control for a 1-volt display, if necessary.

21. Check VOLTS FULL SCALE accuracy

a. Connect the television test signal generator composite video through a 75 Ω termination to the VIDEO INPUT A connector.

b. Adjust the television test signal generator amplitude and APL for a 1-volt display.

c. Set the VOLTS FULL SCALE selector to 0.5 and add the 2X Attenuator in series with the 75 Ω termination.

d. Check for a display amplitude of 1-volt ±3%.

e. Set the VOLTS FULL SCALE switch to 0.2 and replace the 2X Attenuator with the 5X Attenuator.

f. Check for a display amplitude of 1-volt ±3%.

22. Check Horizontal Limiters

a. Connect the video signal source to the VIDEO INPUT A connector.

b. Set the 1480-Series RESPONSE switch to FLAT, DISPLAY switch to 10 μs and MAGNIFIER to .1 μs/Div. Rotate the HORIZONTAL POSITION control throughout its range.

c. Check that the trace is not visibly limited or folded back on screen at any point in the range of the HORIZONTAL POSITION control.

23. Check Magnifier Registration

a. Set the DISPLAY switch to 2 FIELD and center the display, using the HORIZONTAL POSITION control.

b. Set the MAGNIFIER control to X50 and rotate the HORIZONTAL POSITION control to set the last field-sync pulse to graticule center.

c. Set the MAGNIFIER control to OFF.

d. Check that the last field-sync pulse is within 0.5 division of graticule center.

24. Check Horizontal Gain and Timing

a. Disconnect the composite video and connect the time mark generator to the 1480-Series VIDEO INPUT A connector. Set the time mark generator for 10 μs markers.

b. Apply a trigger from the time mark generator to the EXTERNAL SYNC A input connector.

c. Press SYNC EXT and DIRECT pushbuttons.

d. DISPLAY is at 10 μs/DIV.

e. Check for a display of 1 time-mark/div. within 2%.

f. Set the MAGNIFIER switch to 0.1 μs/DIV and the time mark generator for 0.1 μs marks.

g. Check the magnified display for 1 mark/div ±3% over the center 10 divisions of the unmagnified display. Total effective magnified display is 1270 divisions in length (12.7 div., magnified 100X). Specification applies to any portion of the center 1000 divisions at this magnification.

h. Check magnified timing and linearity as in Table 5-3.

Table 5-3

TIME MARKERS	MAG	DISPLAY	LIMIT
1 μs	0.2 μs	1 mark/5 div	±3%
1 μs	0.25 μs	1 mark/4 div	±3%
1 μs	0.5 μs	1 mark/2 div	±2%
1 μs	1.0 μs	1 mark/div	±1%

25. Check WAVEFORM COMPARISON Range

a. Set the DISPLAY switch to 5 μs/DIV and rotate the WAVEFORM COMPARISON OVERLAY control just out of detent. Notice the small blanked portion of the trace.

b. Rotate the WAVEFORM COMPARISON LOCATE control to place the blanked portion at the start of the trace.

c. Rotate the WAVEFORM COMPARISON OVERLAY control throughout its range.

d. Check that the OVERLAY control has sufficient range to position the display until the end of the 5 μs/DIV sweep is at or surpasses the sync tip on the left edge of the screen. (The position limits are +5 divisions beyond the sync tip to −0.5 division short of the sync tip.)

e. Set the DISPLAY switch to 10 μs/DIV and repeat this step.

26. Check RGB/YRGB Operation

a. Connect the video signal source composite video to the VIDEO INPUT A connector and terminate the loop-thru connector in 75 Ω.

b. Set the INPUT switch to A, AC CPL'D, DISPLAY switch to 10 μs/DIV and the MAGNIFIER selector to OFF.

c. Press the SYNC INT and DIRECT pushbuttons.

d. Connect J9034 on the rear panel for RGB/YRGB operation (ground pin D and connect RGB/YRGB steps to pin C).

e. Connect a 3-step staircase from the television test signal generator to J9034 pin C and set the television test signal generator amplitude control for three video lines in 12.7 div. (If the 1480-Series is internally programmed for YRGB, substitute a 4-step staircase.) See Accessories in the rear of this manual for information on mating, male plug (P9034) for use with J9034.

f. Check for a stable display, centered, without compression.

g. Set the DISPLAY selector to 2 FIELD and check for a display that is three fields in 12.7 divisions. (Four fields if connected for YRGB.)

27. Check EXTERNAL HORIZ input (if activated)

For information on how to activate the External Horizontal mode, refer qualified service personnel to OPERATING CHANGES in Section 6 (Installation).

a. Set the DISPLAY switch to EXT.

b. Connect a 5-volt positive-going ramp from the ramp generator to the EXT HORIZ input.

c. Check for a trace that is 10.0 div. ±3%.

28. Check Field Selection

a. Apply a composite video signal from the video signal source to the 1480-Series VIDEO INPUT A connector and terminate the loop-thru connector in 75 Ω.

b. Setup the video signal source to supply known signals in the vertical interval. For example, the NTSC, STOC1, composite test signal on line 17 of the even field.

c. Set the 1480-Series RESPONSE switch to FLAT, DISPLAY selector to 2 FIELD and MAGNIFIER switch to X20.

d. Horizontally position the interval that occurs between the displayed fields to graticule center. When the field selection pushbutton that corresponds to the even field is pressed, the odd field interval will be displayed. Assume that line 17 of the even field is carrying the composite test signal. When the EVEN pushbutton is pressed, the displayed interval is for the odd field and no composite test signal will be displayed on line 17.

Procedure for checking PAL fields, using the Bruch Blanking Sequence, appears in Television Products Application Note number 16, "Verifying the Bruch Blanking Sequence", which is located in Section 3 of this instruction manual. Care should be exercised when making this check, because the sequence may be in error on the video coming from the video signal source.

29. Check Line Selection

a. Connect the video signal source composite video output to the VIDEO INPUT A connector and terminate the loop-thru connector in 75 Ω.

b. Set the VOLTS FULL SCALE selector to 1.0, RESPONSE selector to FLAT, DISPLAY selector to 10 μs/DIV, and MAGNIFIER switch to OFF.

c. Press the LINE SELECTOR DIG and EVEN FIELD pushbuttons.

d. Again set the video signal source for known signals in the vertical interval.

e. Check that the line displayed and the line selected by the 1480-Series LINE SELECTOR switch agree.

f. Press the LINE SELECTOR VAR pushbutton and set the DISPLAY selector to 2 FIELD. Rotate the VAR control and check that the selected line is intensified, and that the intensified zone can be moved the width of the display with the VAR control.

g. Press the LINE SELECTOR 15 LINES pushbutton. Rotate the VAR control and check that fifteen consecutive lines can be intensified and the zone can be moved the width of the display with the VAR control.

30. Check PIX MONITOR OUT and LINE STROBE OUT

a. Connect the video signal source composite video signal to the VIDEO INPUT A connector.

b. Set the RESPONSE selector to FLAT, DISPLAY selector to 2 FIELD, VOLTS FULL SCALE selector to 1.0, and MAGNIFIER switch to OFF.

c. Press LINE SELECTOR VAR pushbutton.

d. Connect the PIX MONITOR OUT connector through a 75 Ω termination to the test oscilloscope vertical input.

e. Check that the line selected by the LINE SELECTOR controls is identified on the 1480-Series display by an intensified zone and on the test oscilloscope display by a 200 mV pedestal. The pedestal should be one-line duration in the 5 μs/DIV DISPLAY and fifteen-lines duration with the 15 LINES pushbutton pressed.

31. Check Sync Range

a. Connect the video signal source composite video signal through a 5X attenuator and 75 Ω termination to the VIDEO INPUT A connector.

b. Set the VOLTS FULL SCALE selector to 0.2, RESPONSE selector to FLAT, and MAGNIFIER switch to OFF.

c. Check for a stable display.

d. Remove the 5X attenuator and the 75 Ω termination. Connect the composite video directly to the VIDEO INPUT A connector.

e. Check for a stable display.

f. Connect the video signal source composite video output through four 75 Ω terminations to the VIDEO INPUT A connector. Connect the other side of the VIDEO INPUT A loop-thru connector to the EXTERNAL SYNC A input connector.

g. Press the SYNC EXT pushbutton and check for a stable display.

h. Remove the four 75 Ω terminations. Connect the composite video signal directly to the VIDEO INPUT A connector and check for a stable display.

i. Replace the composite video with composite sync, connected through a 2X and a 10X attenuator and 75 Ω termination.

j. Check for a stable display.

k. Remove the two attenuators and the 75 Ω termination. Connect the composite sync directly to the VIDEO INPUT A connector.

l. Check for a stable display.

32. Check Sync Input Selector

a. Connect the video signal source composite video to the VIDEO INPUT A connector and terminate the loop-thru connector in 75 Ω. Connect the video signal source composite sync to EXTERNAL SYNC A input connector.

b. Set the VOLTS FULL SCALE selector to 1.0, MAGNIFIER switch to OFF, RESPONSE selector to FLAT, and DISPLAY selector to 2 FIELD. Press the SYNC DIRECT and EXT pushbuttons.

c. Set the Sync Input Selector on the rear panel to EXT SYNC ALWAYS (A), and check for a stable display.

d. Move the composite video to the VIDEO INPUT B connector, set the INPUT selector to B, and check for a stable display.

e. Change the Sync Input Selector to EXT SYNC SWITCHED WITH INPUT SWITCH (A) or (B), and check that the display is not locked.

f. Move the composite sync input to the EXTERNAL SYNC B connector, and check for a stable display.

33. Check Return Loss

a. Connect the return loss bridge output connectors to the test oscilloscope differential comparator inputs. Connect the leveled sine-wave generator output through the 50 Ω to 75 Ω minimum loss attenuator to the return loss bridge Input connector. Set the test oscilloscope differential comparator for differential operation and Volts/Div to .l.

b. Set the leveled sine-wave generator for 50 kHz. Check that the 75 Ω termination is not connected to the Unknown Arm of the return loss bridge, and adjust the leveled sine-wave generator amplitude for a 500 mV display on the test oscilloscope.

c. Connect the return loss bridge unknown arm to the VIDEO INPUT A connector. Terminate the VIDEO INPUT A loop-thru connector with the termination that is normally connected to the Unknown Arm of the return loss bridge.

d. Check that the test oscilloscope amplitude is 2.5 mV or less.

e. Repeat the test for the VIDEO INPUT B and EXTERNAL SYNC A and B inputs.

f. Connect the return loss bridge Unknown Arm (do not terminate) to AUX VIDEO IN, AUX VIDEO OUT, and PIX MONITOR OUT connectors in sequence, while performing part g.

g. Check for a test oscilloscope amplitude of 11 mV or less at each of the connectors mentioned in part f.

Options

The remaining steps in this procedure check the performance of option circuits, beginning with Option 1 (X10 Probe Input). Each Option is identifed individually.

Option 1, X10 Probe Input

Additional Equipment Required:

1. 10X Passive Probe. For example, P6105, Tektronix Part Number 010-6105-01.
2. One 50 Ω feed-thru termination, Tektronix Part Number 011-0049-01.

34. Check X10 PROBE GAIN Range

a. Compensate the 10X probe using the test oscilloscope vertical amplifier and calibrator.

b. Move the 10X probe to the 1480-Series X10 PROBE INPUT. Plug the probe tip into the CAL OUTPUT connector. Switch the INPUT selector to PROBE and press the CAL and DC RESTORER SYNC TIP pushbuttons. Rotate PROBE GAIN to its extremes and check for 1 V, +10% and −10% at the respective ends of the control.

c. Adjust X10 PROBE GAIN for a 1-volt display height.

35. Check 10X PROBE GAIN

a. Press the OPER pushbutton. Connect the video signal source composite video to the VIDEO INPUT A connector. Terminate the loop-thru connector with a 75 Ω feed-through termination. Connect the 10X probe to the open end of the feed-through termination.

b. Compare displays with the INPUT switch alternately in PROBE and A positions. Check for less than 3% (3 mV) change in amplitude from A to PROBE.

36. Check 10X Probe HF Compensation

a. Check that the chrominance packets are identical in the A and PROBE positions of the INPUT switch.

37. Check Probe Calibrator Amplitude

a. Connect the 10X probe between the test oscilloscope and the X10 PROBE CAL OUTPUT.

b. Measure the CAL OUTPUT amplitude, using the differential comparator comparison voltage. Check for 1 V ±0.5% (0.5 mV).

Options 4 and 5, VTR Tone Wheel Sync Input

Additional Equipment Required:

1. Pulse Generator capable of 5 V output into 50 Ω from 5 Hz to 50 MHz, with variable period and duration. For example, Tektronix PG 501. (See item 6 of Equipment Required List.)
2. One 067-0621-00, Calibration Fixture, remote control for VTR waveform monitor.
3. Two coaxial cables, 50 Ω, 42", bnc connectors, 012-0057-01.
4. One 50 Ω Feed-through Termination, 011-0049-01.

38. Check Clamping

a. Connect the pulse generator minus (−) output to the 1480-Series SYNC loop-thru input connector using 50 Ω cable. Connect the second SYNC connector through 50 Ω cable and a 50 Ω termination to the test oscilloscope vertical input.

b. Connect composite video from the video signal source to the 1480-Series VIDEO INPUT A connector and terminate the loop-thru connector in 75 Ω.

c. Connect composite sync from the video signal source to the 1480-Series EXTERNAL SYNC A input connector and terminate the loop-thru connector in 75 Ω.

d. Connect the 067-0621-00 Calibration Fixture to J9034 on the 1480-Series rear panel.

e. Set the 1480-Series DC RESTORER selector to FAST, BACK PORCH, and SYNC to EXT. Set all switches on the 067-0621-00 up (Normal).

f. Set the test oscilloscope Time/Div to 0.5 ms and Volts /Div to 5. Set the pulse generator output amplitude for 3 volts, pulse duration for 300 μs and period for 4.167 ms (4 ms for 625 line scanning system).

g. Rotate the 1480-Series vertical POSITION control to set the back porch of the displayed signal at blanking level.

h. Remove the 75 Ω termination from the VIDEO INPUT A connector. Check that the back porch of the displayed signal is clamped at blanking level. Replace the termination.

i. Set the 067-0621-00 Horizontal Display switch to 2 Field or Tone Wheel. Check to see that the back porch of the displayed signal remains at the blanking level.

j. Remove the termination from the VIDEO INPUT A connector. Check to see that the back porch of the displayed signal is not clamped. Replace the termination.

k. Rotate the DISPLAY switch to each position except EXT and check that the display does not change.

39. Check Sync Stability

a. Set the 067-0621-00 Ext Sync Source switch to Ext. Check for a stable display.

b. Remove the cable from EXTERNAL SYNC A loop-thru connector. Check for an unstable display. Replace the cable. Return the 067-0621-00 Ext Sync Source switch to Int.

40. Check Sweep Length

a. Set the RESPONSE switch to AUX IN. Set the 067-0621-00 Ext Sync mode switch to Tone Wheel. Check that the display does not flicker, remains stable, and is 12.5 div ±0.5 div in length.

41. Check Maximum Input

a. Remove the termination from the test oscilloscope vertical input. Adjust the pulse generator for maximum output amplitude. Check to see that the display is unchanged.

Option 7 Slow Sweep

Additional Equipment Required:
One video signal source capable of generating a bounce signal. For example, TEKTRONIX 148 (PAL), 148-M (PAL-M), or 149A (NTSC) Test Signal Generator.

42. Check SLOW SWEEP Speed

a. Connect the output of the time mark generator to the 1480-Series VIDEO INPUT A connector. Set the DISPLAY switch to SLOW SWEEP + TRIG PLRT. Apply 1-second time marks.

b. Rotate the VAR DISPLAY control fully clockwise and check for five or less time marks per sweep.

c. Rotate the VAR DISPLAY control fully counterclockwise and check for 12 or more time marks per sweep.

43. Check SLOW SWEEP Trigger Polarity

a. Disconnect the cable from the time mark generator and connect it to the test signal generator Composite Video output. Set the test signal generator for an APL Bounce signal.

b. Check the start of the display. Display begins at maximum APL.

c. Change SLOW SWEEP TRIG PLRT to − (minus). Check start of the sweep; display should begin with trace at the blanking level.

Option 7 50/60 Hertz Triggering

Additional Equipment Required:

1. Pulse generator capable of 5 V output into 50 Ω from 5 Hz to 50 MHz, with variable period and duration. For example, TEKTRONIX PG 501. A function generator, such as the TEKTRONIX FG 503, may be substituted. (See item 6 of the Test Equipment Required list.)
2. Three Coaxial Cables, 50 Ω, 42", bnc connectors, 012-0057-01.
3. One 50 Ω Feed-Through Termination, bnc connectors, 011-0049-01.
4. One 50 Ω X10 Attenuator, bnc connectors, 011-0059-02.

44. Check 50/60 Hz Triggering Sensitivity

a. Connect the output of the pulse generator through a 50 Ω coaxial cable to the 1480-Series AUX SYNC INPUT. Loop-thru connect, with a 50 Ω coaxial cable, to the VIDEO INPUT A connector. Connect another 50 Ω coaxial cable from the other side of the VIDEO INPUT A loop-thru connector to the test oscilloscope vertical input, through the 50 Ω feed-through termination.

b. Using the test oscilloscope as an amplitude monitor, set the pulse generator for 3 volts of 50 Hz signal.

c. Set the 1480-Series DISPLAY selector to 2 FIELD and depress both INT and EXT SYNC pushbuttons.

d. Check for a triggered 1480-Series display of 2 full cycles of square wave.

e. Install the 50 Ω X10 attenuator in the cable from the pulse generator to the AUX SYNC INPUT. Using the test oscilloscope as an amplitude monitor, set the pulse generator for 400 mV at 50 Hz.

f. Check for a triggered 1480-Series display of 2 full cycles of square wave.

45. Check 50/60 Hz Triggering Frequency Range

a. Using the test oscilloscope as an amplitude monitor, set the pulse generator amplitude to 1 volt.

b. Rotate the pulse generator frequency control from 50 to 60 Hz and check for a triggered display of 2 full cycles of square wave from 50 to 60 Hz. (Disregard a small jump that occurs near 55 Hz. This is normal and provides for almost identical sweep length at 50 and 60 Hz).

WARNING

THE FOLLOWING SERVICING INSTRUCTIONS ARE FOR USE BY QUALIFIED PERSONNEL ONLY. TO AVOID PERSONAL INJURY, DO NOT PERFORM ANY SERVICING OTHER THAN THAT CONTAINED IN OPERATING INSTRUCTIONS UNLESS YOU ARE QUALIFIED TO DO SO. REFER TO OPERATORS SAFETY SUMMARY AND SERVICE SAFETY SUMMARY PRIOR TO PERFORMING ANY SERVICE.

PART II
SERVICE & INSTALLATION INFORMATION

INTRODUCTION

Service instructions are intended for use by qualified personnel only. To avoid electrical shock, do not attempt any servicing other than that contained in the OPERATING INFORMATION (PART I) unless you are qualified to do so.

Please read the Safety Summary that is located immediately following the Table of Contents.

INSTALLATION

ELECTRICAL

Power Requirements

Safety. The 1480-Series Waveform Monitors are designed to operate from a single-phase power source with one of the current-carrying conductors (the neutral) at ground (earth) potential. Only the Line conductor has over-current (fuse) protection within the instrument. In accordance with international standards, the instruments are provided with a detachable 3-wire power cord with a 3-terminal polarized plug for connection to the power source. The ground (earth) terminal of the plug is directly connected to the instrument frame. For electrical shock protection, insert this plug only into a mains supply outlet with a safety-earth contact.

Main Supplies. The 1480-Series Waveform Monitors will operate over a mains frequency range of 48 to 62 Hz and at nominal mains voltage of 110 Vac or 220 Vac. Power consumption at center values of the mains voltage ranges is nominally 60 W, with a maximum of 75 W at low line conditions. Power transformer primary taps are provided to select any one of the three ranges for the two nominal mains voltage sources. See Fig. 6-1.

Mains Ranges and Fuses

Checking. Make sure the instrument is disconnected from any power source. Remove the bottom dust cover (of either the rack or cabinet model). Referring to the illustrations in Fig. 6-1, verify that the power transformer wiring matches the range labeled on the rear panel of the instrument. Check the fuse installed at the rear of the instrument, for agreement with both transformer primary wiring and the rear-panel fuse data for the mains voltage.

Conversion. Occasionally the factory-wired range may not be compatible with the available mains supply. In this case, choose one of the three possible ranges whose center value is closest to the mains voltage to be used during regular operation. Change the jumper wiring according to Fig. 6-1.

Replace the voltage label on the rear panel with the appropriate stick-back label from the set of six, supplied with the standard accessory package.

Re-check the fuse rating.

Replace the bottom dust cover.

Internal Programming

Before mounting the waveform monitor in a rack or cradle assembly, the internal, factory-set programming plugs should be checked to verify that the instrument will be compatible with the operating system for which it is intended.

Remove the top cover of the rackmount model, or the two side covers of the cabinet model, to gain access to the circuit boards and plug-jumpers.

Referring to Fig. 6-2, check or change the plug-jumpers to satisfy system requirements. Detailed directions for setting up the alternative modes can be found under the heading of Operating Changes.

MECHANICAL

The dust covers of the 1480-Series Waveform Monitors provide for proper electrical environment for the instruments, minimize handling damage, reduce dust collection within the instruments, and provide personnel protection from shock hazards. The covers (or optional field case for the cabinet models) should always remain in place except for servicing by qualified persons.

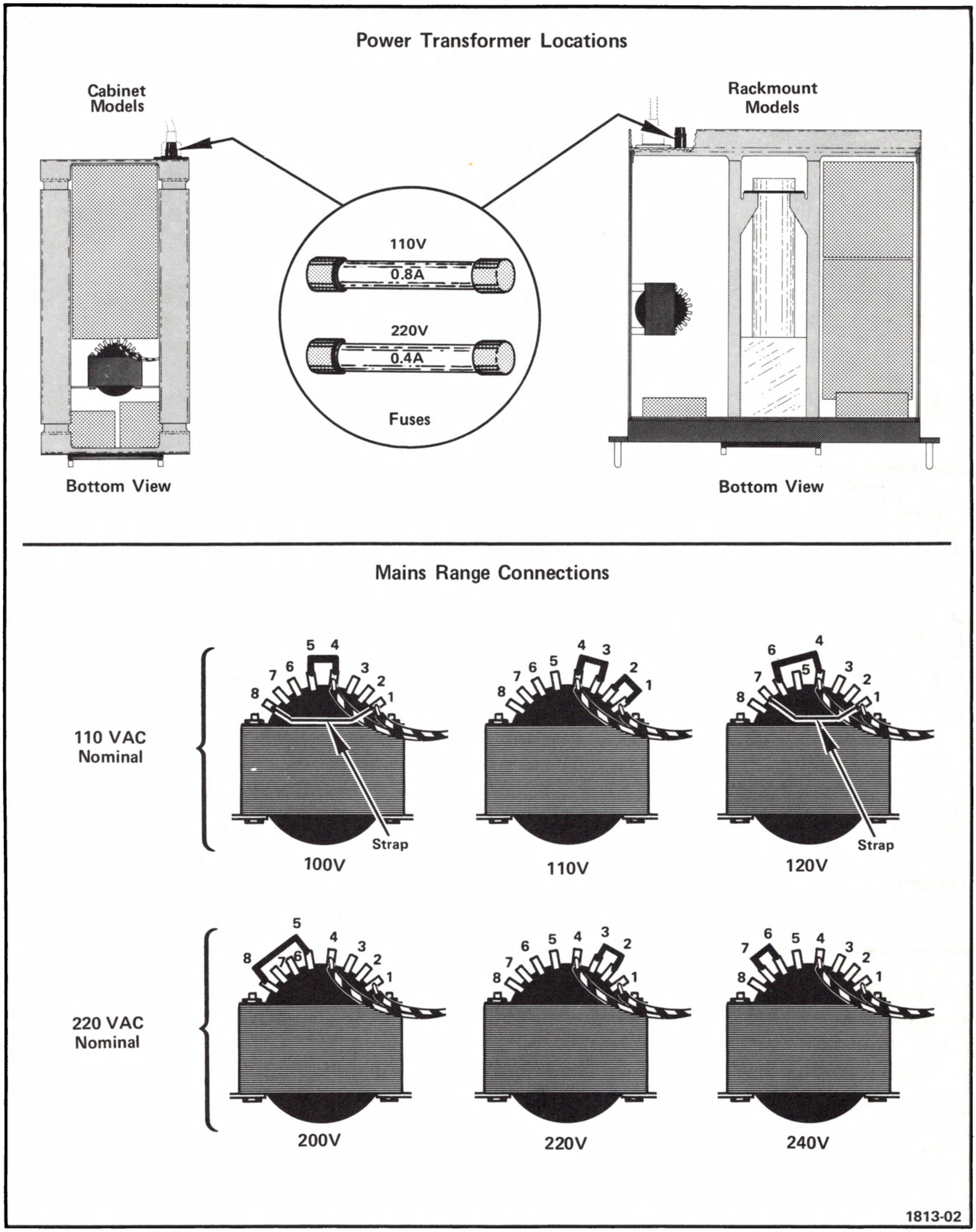
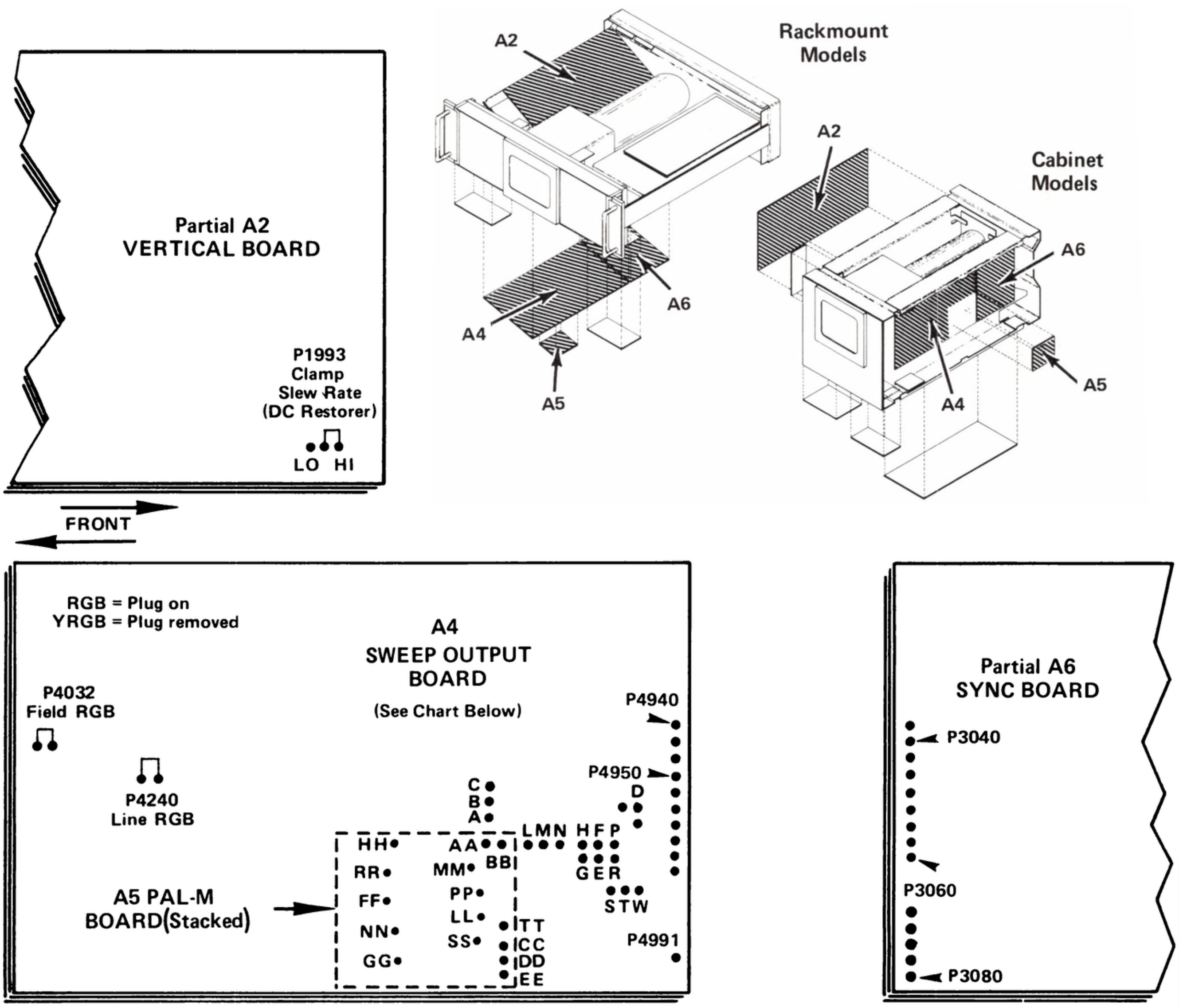

Power Transformer Locations
Cabinet Models
Rackmount Models
110V
0.8A
220V
0.4A
Fuses
Bottom View
Bottom View
Mains Range Connections
110 VAC Nominal
Strap
100V
110V
Strap
120V
220 VAC Nominal
200V
220V
240V
1813-02

Fig. 6-1. Power transformer locations and primary wiring.

ELECTRICAL PROGRAMMING


Rackmount Models
A2
A2
Cabinet Models
A6
A6
A4
A4
A5
A5
Partial A2 VERTICAL BOARD
P1993 Clamp Slew Rate (DC Restorer)
LO HI
FRONT
RGB = Plug on
YRGB = Plug removed
P4032 Field RGB
P4240 Line RGB
A4 SWEEP OUTPUT BOARD
(See Chart Below)
P4940
P4950
P4991
C
B
A
D
LMN
HFP
GER
STW
HH
RR
FF
NN
GG
AA
BB
MM
PP
LL
SS
TT
CC
DD
EE
A5 PAL-M BOARD(Stacked)
Partial A6 SYNC BOARD
P3040
P3060
P3080

PAL FRAME PULSE GATE INTERCONNECTION CHART

(1813)2338-27C

Standards Single or dual	P4950-5 from	P4991-1 to	P4950-7 from	Pin TT to	The remaining interconnections for the Pal Frame Pulse Gate are listed below:							
NTSC (525/60)	NA	NA	NA	NA	B-C	E-F	G-H	L-M	P-R	T-S		
PAL (625/50)	NA	P3080-1	P3060-1	NA	A-B	E-F	G-H	L-M	P-R	T-S		
PAL-M (525/60)	NA	NA	P3060-1	P3080-1	A-B	C-E	F-H	L-M	P-R	S-EE	T-DD	AA-BB
NTSC + PAL	P3060-3	P3080-1	P3060-1	NA		E-F	G-H	L-M	P-R	T-S		

Fig. 6-2. Operating program changes.

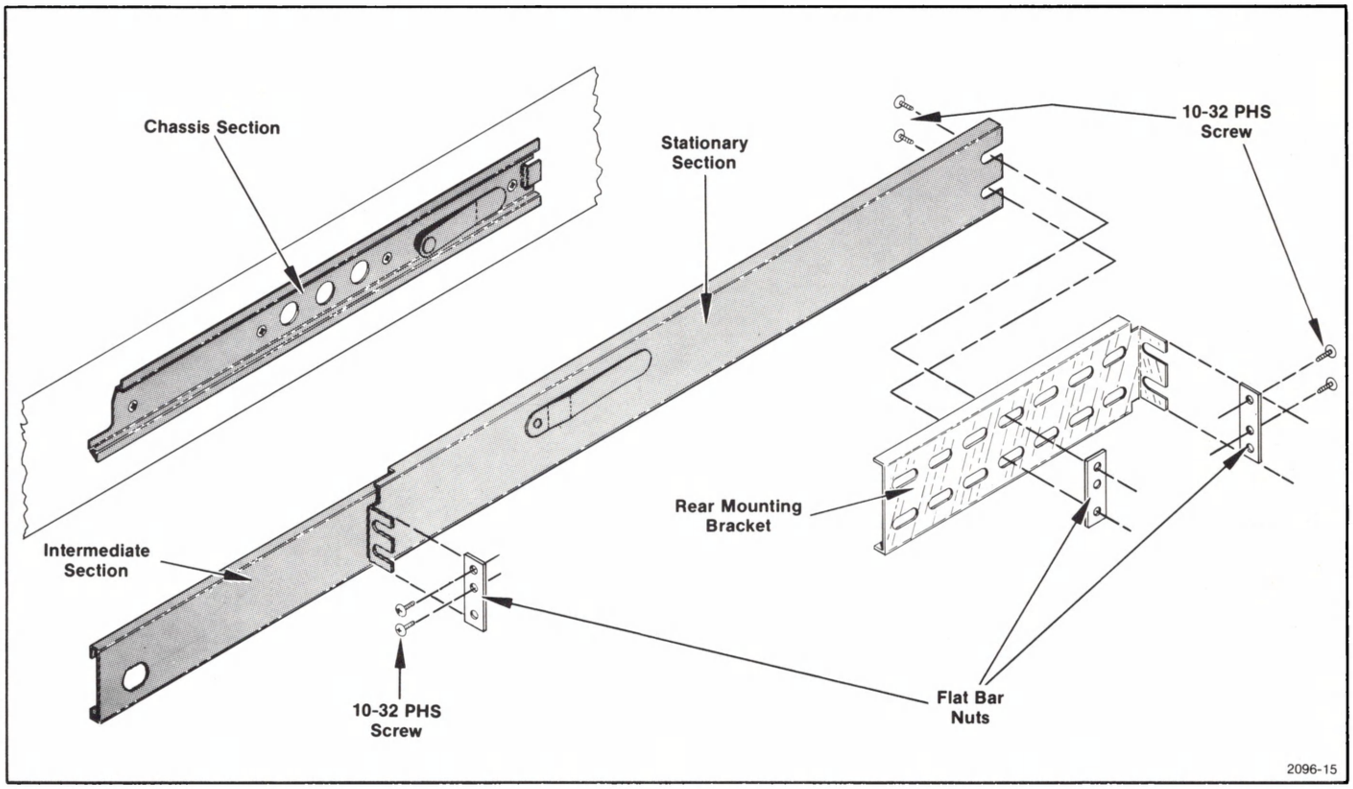


Fig. 6-3. Exploded view of rackmounting hardware.

Rackmounting

This heading obviously pertains only to the 1480-Series rackmount models. Instructions for mounting and caring for cabinet models appear later.

Figure 6-3 shows an exploded view of the rackmounting hardware for installing the instrument in a cabinet rack.

The stationary section with its intermediate section and rear-mounting extension bracket are fastened to the front and rear rails of the cabinet rack. Then, the instrument with attached slideout track chassis-sections slides into the intermediate section to complete the installation.

Mounting

This instrument will fit most commercial consoles and most 19"-wide racks whose front-and rear-rail holes conform to universal hole spacing. An extra hole in each rail must be drilled, and tapped if desired, to permit mounting in a rack having EIA/RETMA/Western Electric hole spacing. See Fig. 6-4.

Figure 6-5 shows the instrument installed in a cabinet-type rack with 1-3/4 inch wide slide-out tracks for a non-tilt installation. The instrument is secured into the rack by means of two hurled thumb screws. When the thumb screws on the front panel are loosened to release the instrument, the instrument can be pulled out of the rack like a drawer to its fully extended position (see Fig. 6-6). This position permits many routine maintenance functions to be performed without completely removing the instrument from the rack.

The slide-out tracks easily mount to the cabinet-rack front and rear vertical mounting rails if the inside distance between the front and rear rails is within 10-5/16 inches to 24-3/8 inches. Some means of support (for example, make extensions for the rear mounting brackets) is needed to support the rear ends of the slide-out tracks if the tracks are going to be installed in a cabinet track whose inside dimension between front and rear rails is not the proper distance (10-5/16 inches to 24-3/8 inches).

Instrument Dimension

Instrument dimensions are shown on pull-out pages in Section 11.

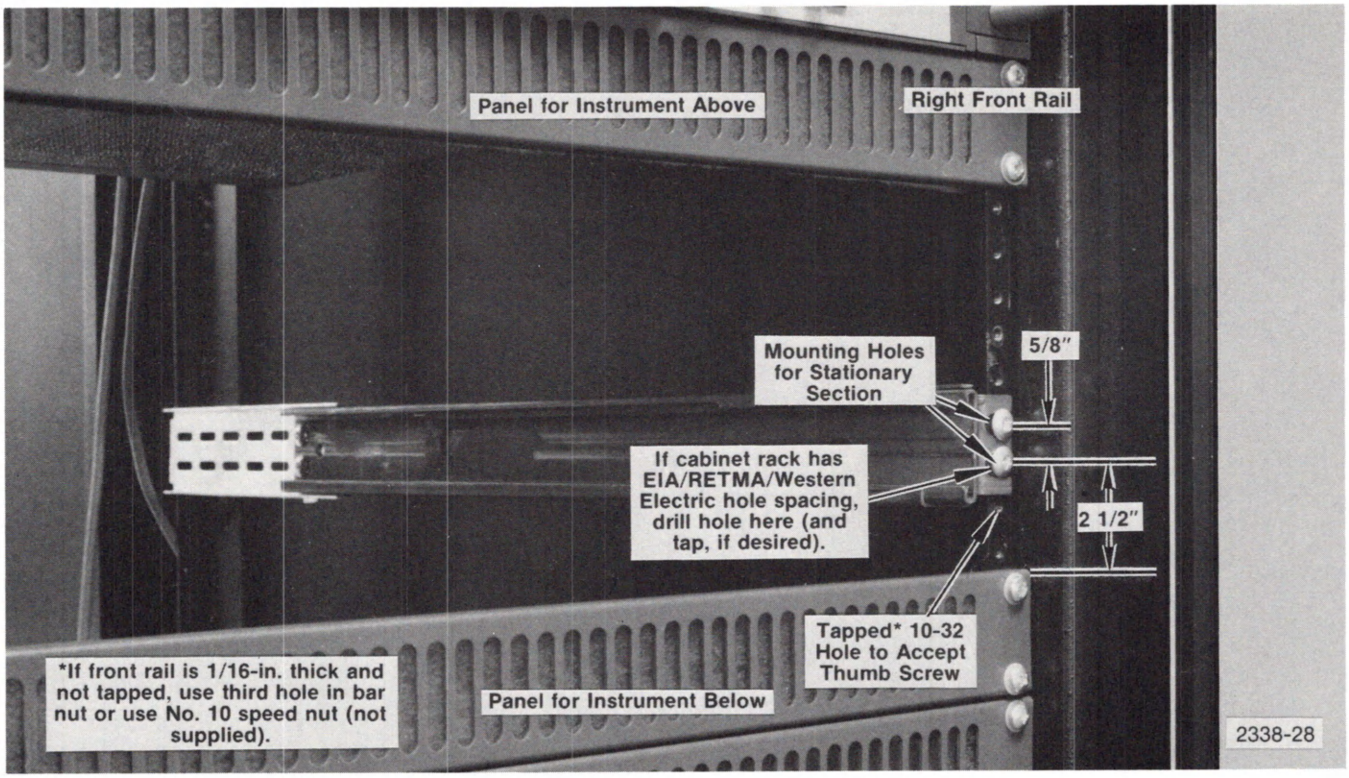

Panel for Instrument Above
Right Front Rail
Mounting Holes for Stationary Section
5/8"
If cabinet rack has EIA/RETMA/Western Electric hole spacing, drill hole here (and tap, if desired).
2 1/2"
Tapped* 10-32 Hole to Accept Thumb Screw
*If front rail is 1/16-in. thick and not tapped, use third hole in bar nut or use No. 10 speed nut (not supplied).
Panel for Instrument Below
2338-28

Fig. 6-4. Spacing for mounting a 1480-Series Rackmount.

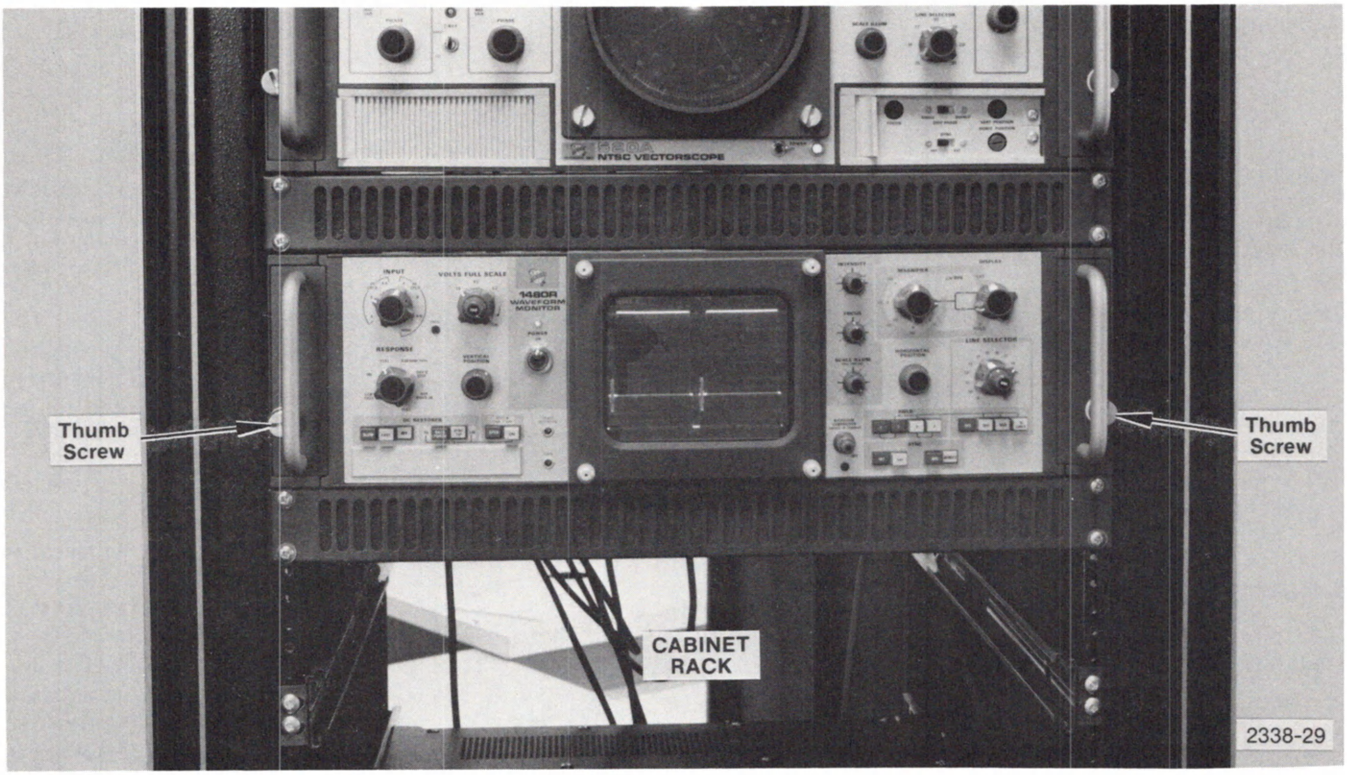

Thumb Screw
Thumb Screw
CABINET RACK
NTSC VECTORSCOPE
1480R WAVEFORM MONITOR
2338-29

Fig. 6-5. 1480-Series rackmount correctly mounted in a 19" rack.

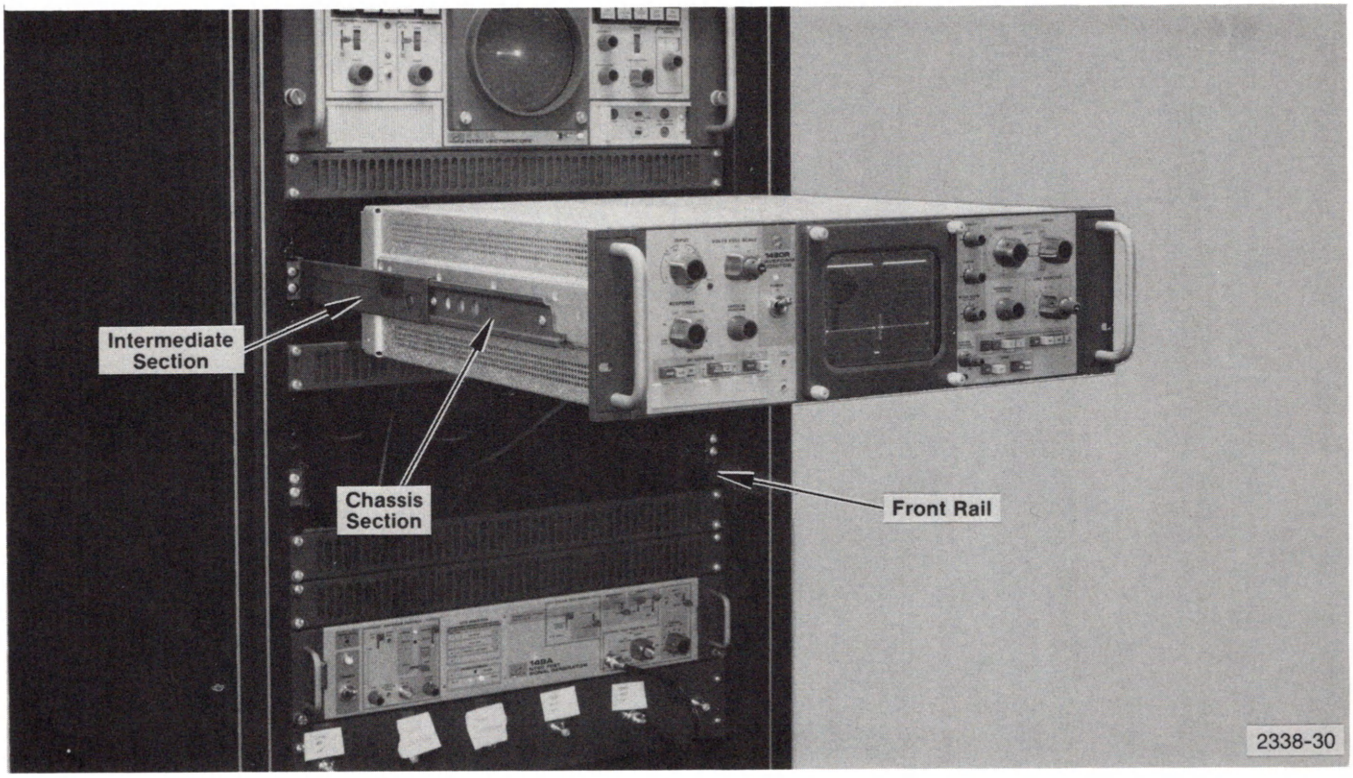


Fig. 6-6. 1480-Series rackmount fully extended on rackmounting slides.

Rack Dimensions

Width—A standard 19-inch rack may be used. The dimension or opening between the front rails must be at least 17.750 inches (see Fig. 6-7).

Depth—For proper circulation of cooling air, allow at least 2 inches clearance between the rear of the instrument and any enclosure on the rack. If it is sometimes necessary or desirable to operate the Waveform Monitor in the fully extended position, use cables that are long enough to reach from the signal source to the instrument.

Mounting Procedure

Use the following mounting instructions along with Figs. 6-8 and 6-9.

1. To mount the instrument directly above or below another instrument in the cabinet rack, select the appropriate holes in the front rack rails for the stationary sections using Fig. 6-7 as a guide.

2. Mount the stationary slide-out track sections to the front rack rails using either of these methods:

(a) If the front flanges of the stationary sections are to be mounted behind the front rails (rails are countersunk or not tapped), mount the stationary sections as shown in Fig. 6-8A: Note that the bar nut is positioned so the 1/2-inch spaced holes are located near the top so the uppermost threaded hole will accept the thumb screw when instrument is fully installed. This applies if the front rails are 1/16-inch thick as noted earlier.

(b) If the front flanges of the stationary sections are to be mounted in front of the front rails (rails are tapped for 10-32 screws), mount the stationary sections as shown in Fig. 6-8B illustration. To provide increased bearing surface for the screw head to securely fasten the front flange to the rail, a flat washer (not supplied) may be added under the screw head. However, when using this mounting method, the front panel will not fit flush against the front rail because of the stationary section and washer thickness. If a flush fit is preferred, the method in step 2(a) should be used.

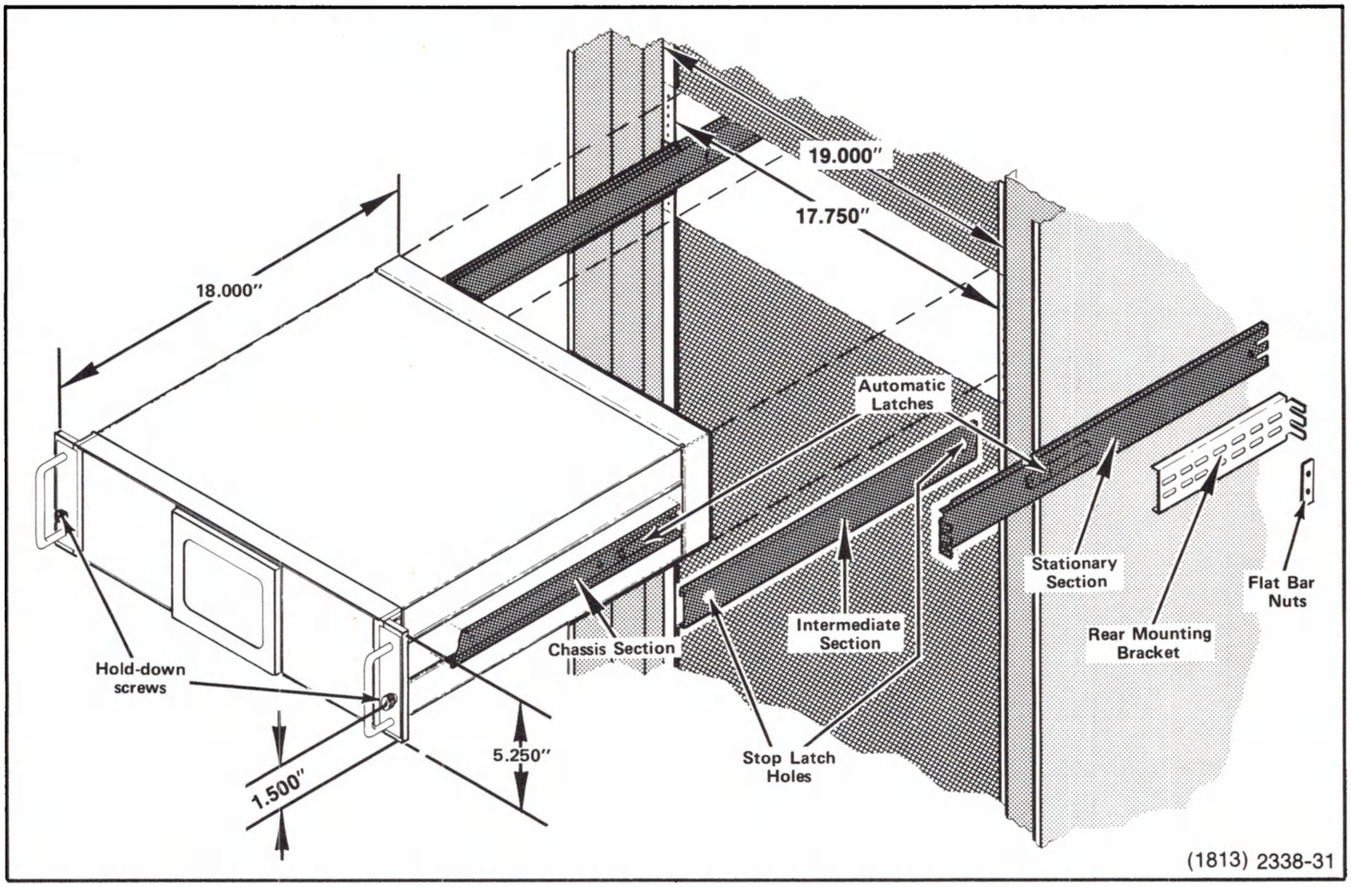

19.000"
17.750"
18.000"
Automatic Latches
Stationary Section
Flat Bar Nuts
Rear Mounting Bracket
Intermediate Section
Chassis Section
Hold-down screws
5.250"
1.500"
Stop Latch Holes
(1813) 2338-31

Fig. 6-7. Rackmounting dimensions.

3. Mount the stationary slide-out track sections to the rear rack rails using either of these methods:

(a) If the rear rack rail holes are not tapped to accept 10-32 machine screws, mount the stationary sections, with hardware, with bar nut and flange on opposite side of rear rails from screw head. Note that the rear mounting bracket can be installed either way, so the slide-out tracks will fit a deep or shallow cabinet rack, as shown in Fig. 6-9A. Make sure the stationary sections are horizontally aligned so they are level and parallel with each other.

(b) If the rear rack rail holes are tapped to accept 10-32 machine screws, mount the stationary sections with hardware provided. Screws now mount directly through flange into tapped holes. To provided increased bearing surface for the screwhead, a flat washer (not supplied) may be added under the screwhead. Note that the rear mounting bracket can be installed either way so the slide-out tracks will fit a deep or shallow cabinet rack, as shown in Fig. 6-9B. Make sure the stationary sections are horizontally aligned so they are level and parallel with each other.

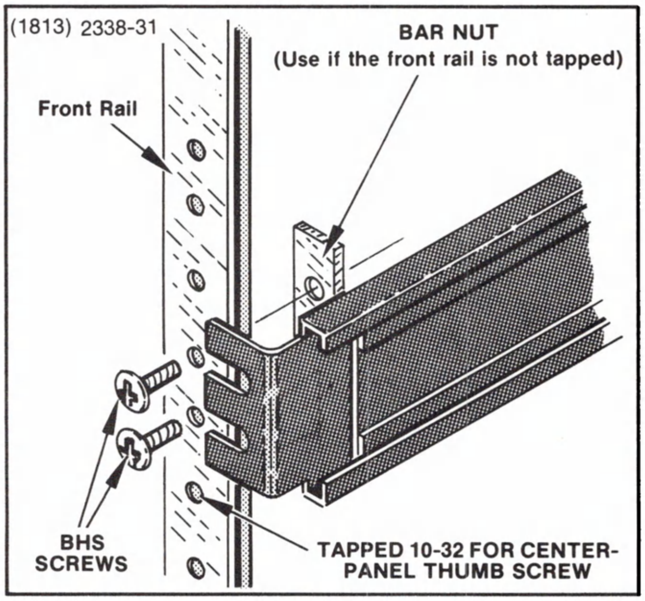

(1813) 2338-31
BAR NUT
(Use if the front rail is not tapped)
Front Rail
BHS SCREWS
TAPPED 10-32 FOR CENTER-PANEL THUMB SCREW

Fig. 6-8. Front rail mounting. (A) Flange behind drilled rail. (B) Flange mounted in front of drilled rail.

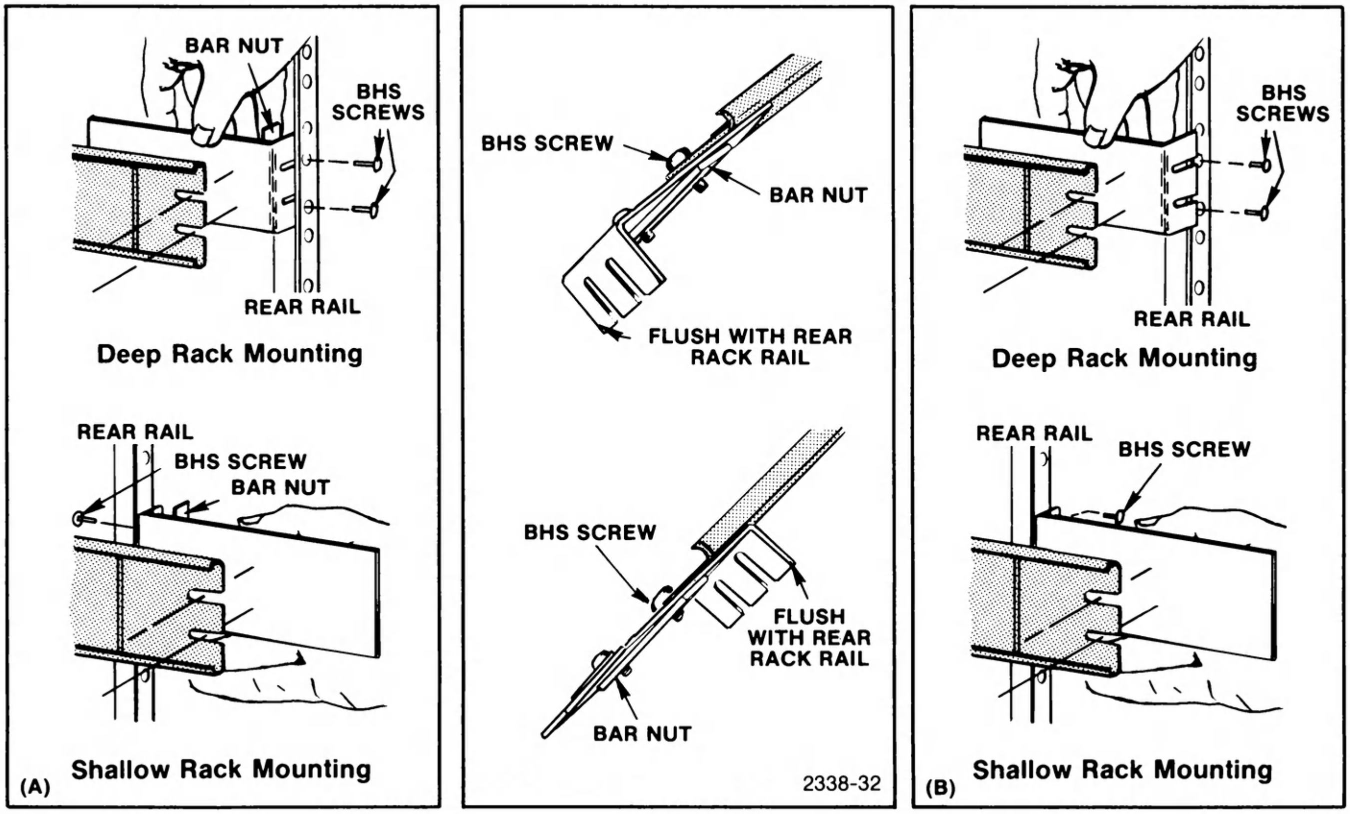
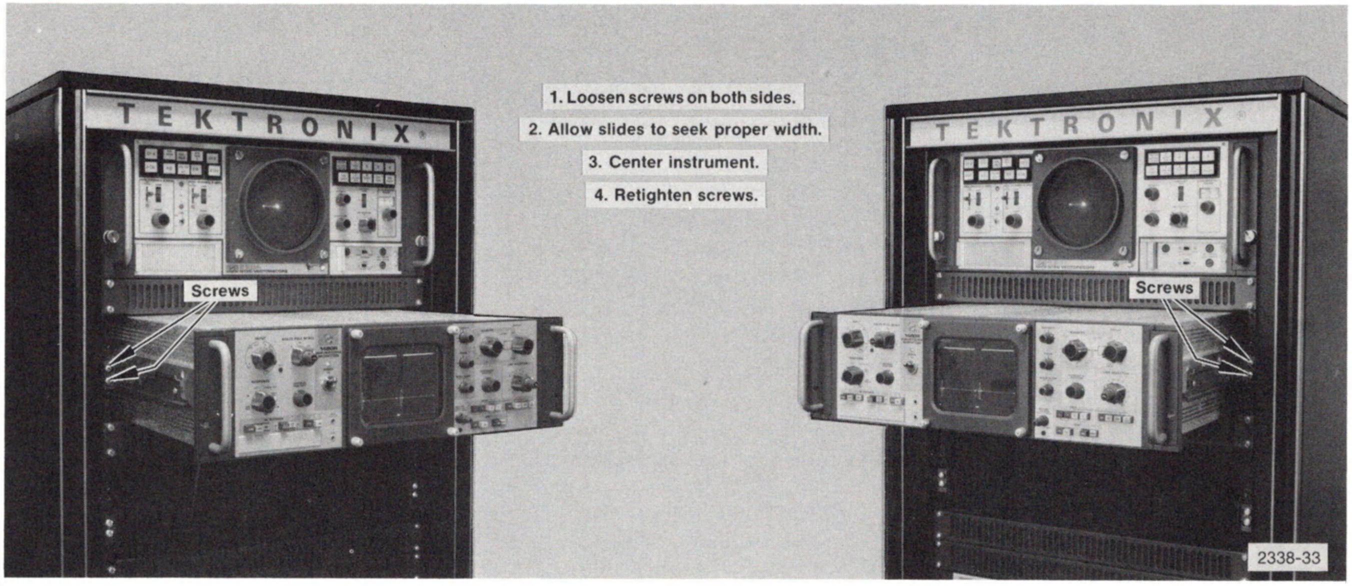

BAR NUT
BHS SCREWS
REAR RAIL
Deep Rack Mounting
REAR RAIL
BHS SCREW
BAR NUT
(A)
Shallow Rack Mounting
BHS SCREW
BAR NUT
FLUSH WITH REAR RACK RAIL
BHS SCREW
FLUSH WITH REAR RACK RAIL
BAR NUT
2338-32
BHS SCREWS
REAR RAIL
Deep Rack Mounting
REAR RAIL
BHS SCREW
(B)
Shallow Rack Mounting

Fig. 6-9. Rear rail mounting. (A) Non-tapped rail mounting using bar nut. (B) Tapped rail mounting with no bar nut.


1. Loosen screws on both sides.
2. Allow slides to seek proper width.
3. Center instrument.
4. Retighten screws.

TEKTRONIX
Screws
TEKTRONIX
Screws
2338-33

Fig. 6-10. Slide Adjustment.

Adjustments

To adjust the slide-out tracks for smooth operation, proceed as follows:

1. Insert the instrument into the rack as shown in Fig. 6-10.

2. Adjust the slide-out tracks for proper spacing as shown in Fig. 6-10.

Maintenance

The slide-out tracks require no lubrication. The special dark-gray finish on the sliding parts is a permanent lubrication.

Cabinet Models

The cabinet models are designed to be mounted in standard 19-inch racks or consoles, using cradle and bezel assemblies. See Fig. 6-11. Cradles and bezels are available from Tektronix for mounting two 1480 Series Waveform Monitors side-by-side, or one Waveform Monitor to the left or right side of 8-inch or 9-inch picture monitors. An optional field case is also available for operation outside a rack or console environment. Consult the Tektronix Television Products Catalog for the appropriate part numbers.

Threaded holes are provided in the bottom chassis rails so the cabinet mode can be securely fastened to the cradle shelf or its optional field case. Figure 6-12 illustrates mounting hole locations. See the foldouts at the rear of this manual for detailed dimensional drawings.

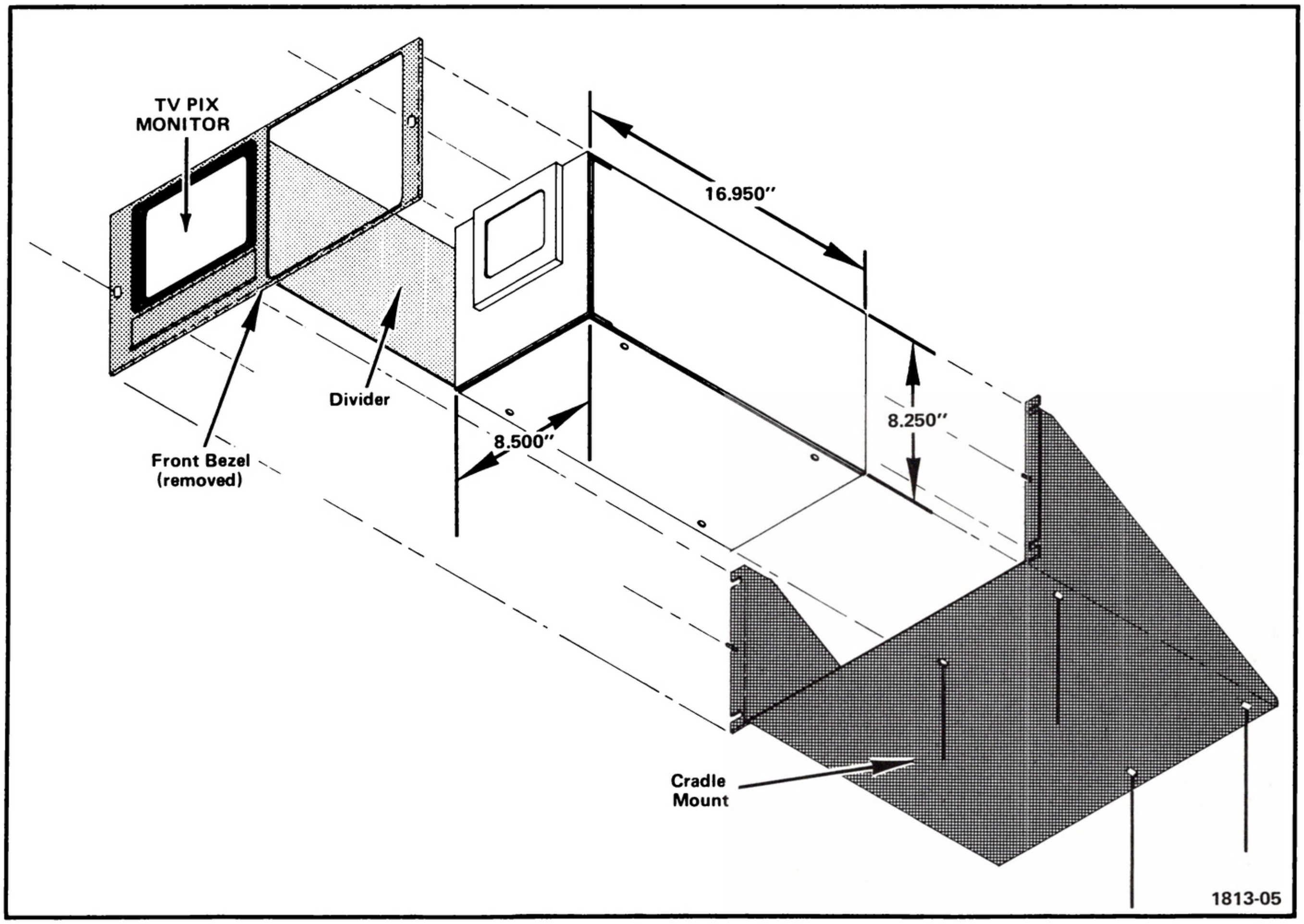


Fig. 6-11. Typical cradle-mount installation.

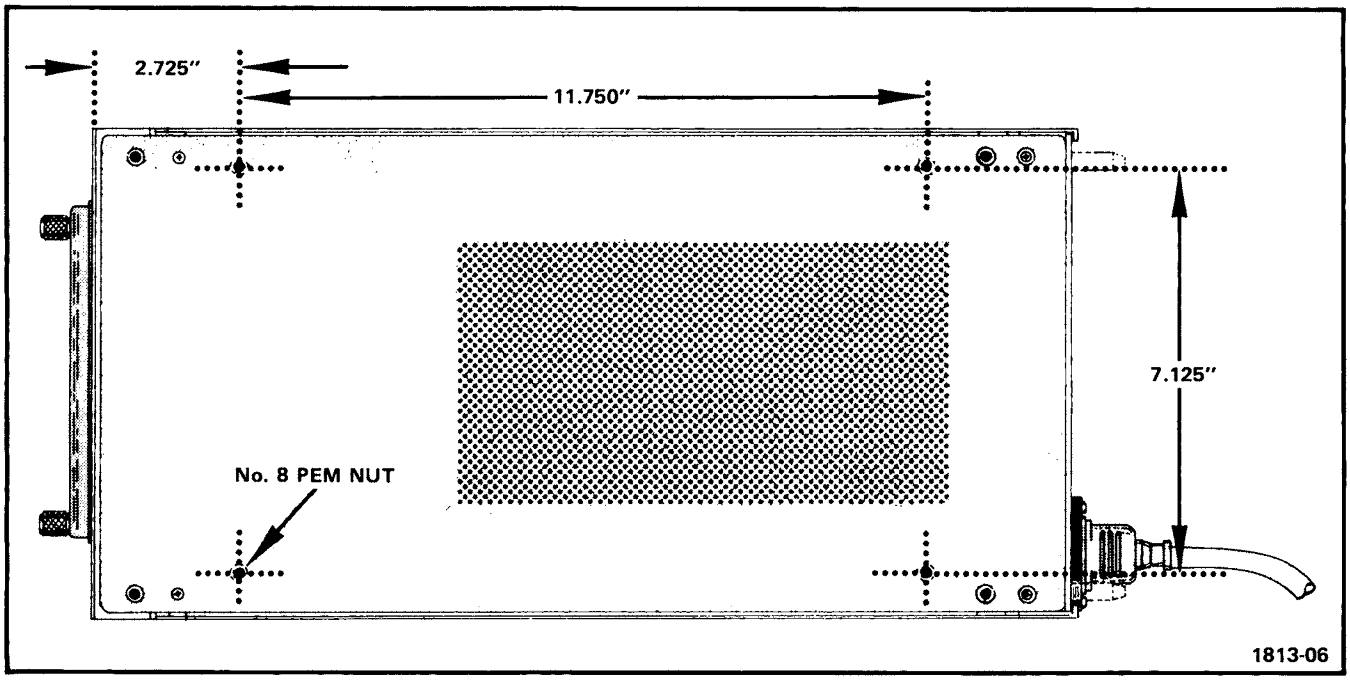


Fig. 6-12. Location of cradle or field case mounting holes.

Option 4 or 5

1480-Series Option 4 or 5 Waveform Monitor is a direct retrofit for the TEKTRONIX 529 installed in RCA TR70C Television Tape Records. Bnc male to uhf female adapters must be used on the six loop-thru lines that connect to inputs on the rear panel of the waveform monitor. (A VIDEO INPUT, A EXT SYNC INPUT, and AUX SYNC.) No provision is made for an external calibration signal on the 1480-Series Option 4 or 5. See Fig. 6-13 for installation illustrations.

OPERATING CHANGES

Some functions of the 1480-Series Waveform Monitors can be altered by the position of certain plug-jumpers. Those functions are listed here.

External Horizontal (P4940)

Unblanking for external horizontal operation is disabled when a 1480-Series Waveform Monitor is shipped. To activate the unblanking, pull P4940, and move the wire in the first slot to the second slot. Then, re-install the plug.

CAUTION

Before turning on the 1480-Series, after changing to external horizontal (EXT) operation, be sure that the INTENSITY control is fully counterclockwise to prevent burning the cathode-ray tube phosphor.

Fast Clamp Slew-Rate (P1993)

When R1893 shown on Diagram 3 is connected directly to +15 volts, the sample-and hold device, U1890, is turned on very hard during clamp time. This allows rapid restoration of the signal, but the circuit is somewhat more susceptible to noise. Fig. 6-14 shows the location of P1993.

2 FIELD RGY/YRGB (P4032)

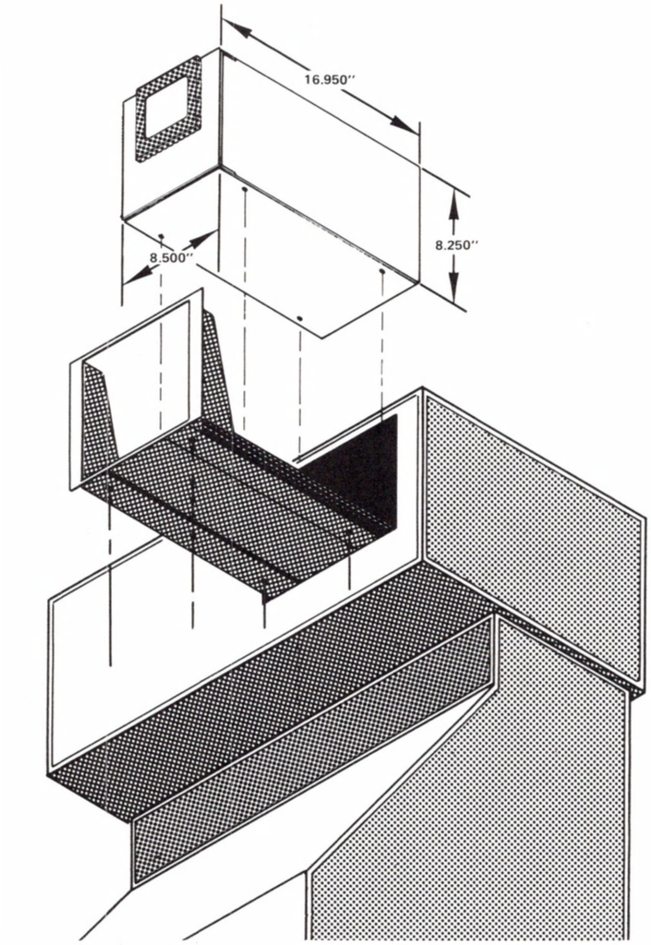
When this plug-jumper is connected, it shorts across R4032 (shown on Diagram 10). With R4032 shorted, the gain of the amplifier is one-third normal, allowing for a three-step (RGB) display. With P4032 removed, amplifier gain is one-fourth normal, allowing for a four-step (YRGB) display. Figure 6-15 shows the location of P4032.

Line Sweep RGY/YRGB (P4240)

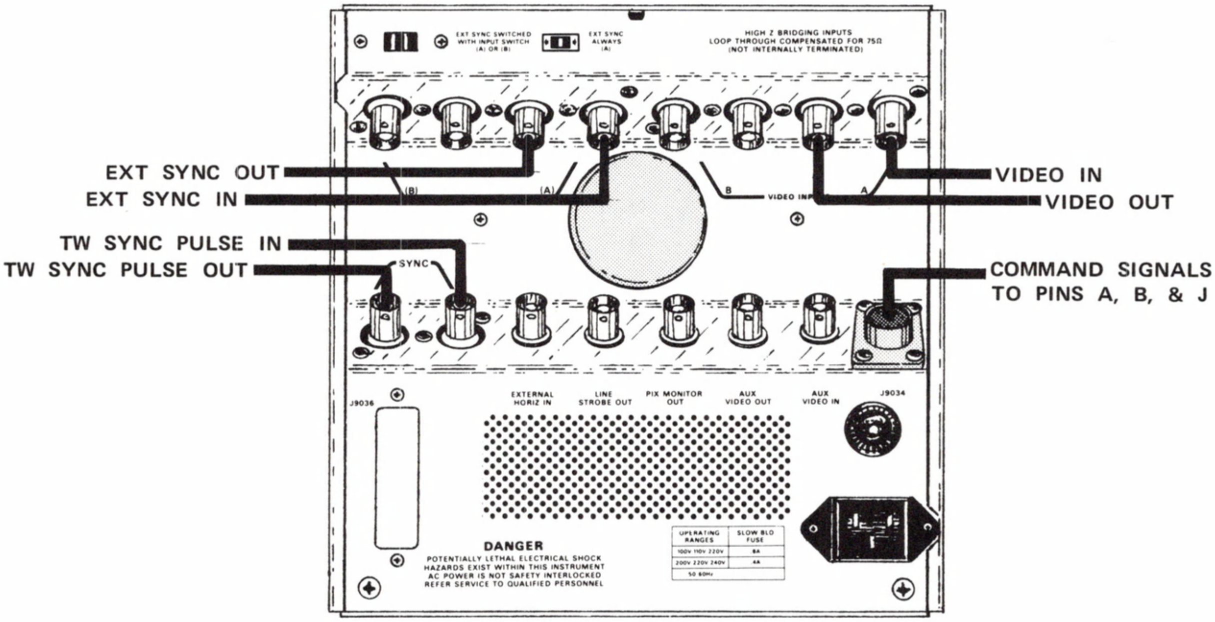
P4240 performs the identical function for 5 μs/DIV and 10 μs/DIV sweep speeds as P4032 does for 2 FIELD. See Fig. 6-15 for location of P4240.

Changing RGB/YRGB Sweep Length

If the sweep is too long to display all of the parade, increase the value of R4140 and R4242 by a ratio equal to the % of over-sweep. Both resistors are shown in Fig. 6-14.


16.950"
8.250"
8.500"

1813-58


EXT SYNC SWITCHED WITH INPUT SWITCH (A) OR (B)
EXT SYNC ALWAYS (A)
HIGH Z BRIDGING INPUTS LOOP THROUGH COMPENSATED FOR 75Ω (NOT INTERNALLY TERMINATED)
EXT SYNC OUT
EXT SYNC IN
(B)
(A)
B
VIDEO IN
A
VIDEO IN
VIDEO OUT
TW SYNC PULSE IN
TW SYNC PULSE OUT
SYNC
COMMAND SIGNALS TO PINS A, B, & J
J9036
EXTERNAL HORIZ IN
LINE STROBE OUT
PIX MONITOR OUT
AUX VIDEO OUT
AUX VIDEO IN
J9034
DANGER
POTENTIALLY LETHAL ELECTRICAL SHOCK HAZARDS EXIST WITHIN THIS INSTRUMENT AC POWER IS NOT SAFETY INTERLOCKED REFER SERVICE TO QUALIFIED PERSONNEL
OPERATING RANGES
SLOW BLO FUSE
100V 110V 220V
.8A
200V 220V 240V
.4A
50 60Hz

1813-59

Fig. 6-13. Installation of 1480-Series cabinet model Option 4 or 5.

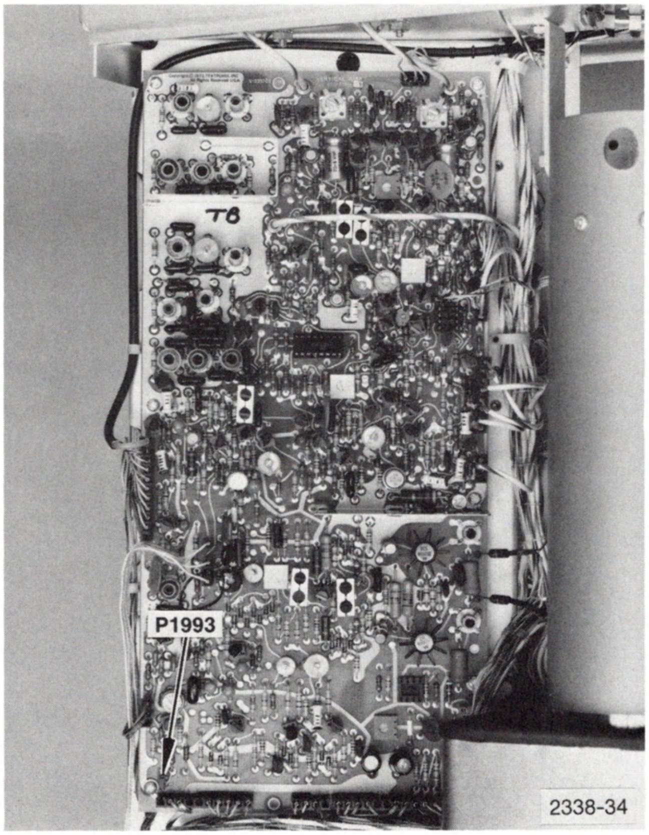

T8
P1993
2338-34

Fig. 6-14. Location of Clamp Slew Rate plug.

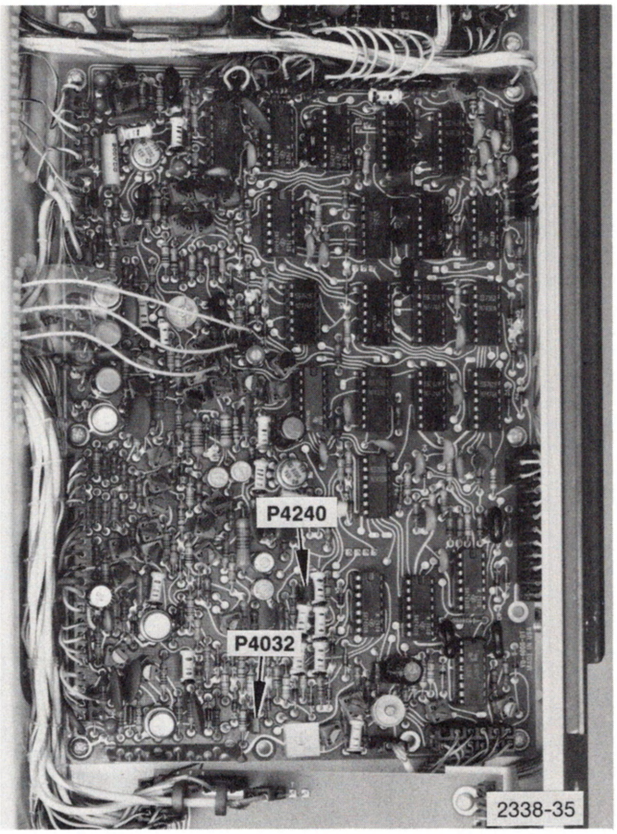

P4240
P4032
2338-35

Fig. 6-15. Location of the RGB/YRGB program plugs.

MAINTENANCE

The maintenance information contained in this section falls into three categories; Preventive Maintenance, Troubleshooting, and Corrective Maintenance.

Preventive Maintenance includes instructions for inspection, cleaning, and lubrication. Troubleshooting provides information for isolating a trouble to an individual circuit or component. Corrective Maintenance includes specific procedures for removing and replacing components.

PREVENTIVE MAINTENANCE

A regular schedule of preventive maintenance can improve instrument reliability. How often the preventive maintenance schedule is performed should be determined by the severity of the operating environment.

Visual Inspection

Visually inspect the instrument during routine preventive maintenance for such defects as broken connectors, loose or disconnected pin connectors, improperly seated transistors and integrated circuits, and damaged components.

The corrective procedure for most visible defects is obvious; however, care must be taken to determine and correct the cause of heat-damaged components. Heat damage is frequently an indication of troubles elsewhere in the instrument.

Multi-Pin Connectors

Most inter-circuit connections between the circuit boards or between boards and chassis-mounted components are made through multi-pin connectors. The connector holder has identification numbers that identify terminal connector number 2 and up. A triangular key symbol is also located on the circuit board to identify pin number 1 (see Fig. 7-1) so that the connector holder can be properly oriented.

Cleaning

Dust accumulating in the instrument acts as an insulating blanket, preventing efficient heat dissipation, and possibly causing overheating and component breakdown. Accumulated dust can also provide an electrical conduction path, especially under high humidity conditions.

CAUTION

Avoid the use of chemical cleaning agents that might damage the plastics used in this instrument. Avoid chemicals that contain benzene, toluene, xylene, or similar solvents.

Interior. The best way to remove accumulated dust inside the instrument is to blow it off with dry, low-velocity air. Remaining dust can be removed with a small paint brush followed by a soft cloth dampened in a mild detergent and water solution. A cotton-tipped applicator is useful in tight places.

Exterior. Remove accumulated dust with a soft cloth or small paint brush. The brush is particularly useful around the front-panel controls.

Remaining dust can be removed with a soft cloth, dampened in a mild detergent and water solution. Do not use abrasive cleaners.

CRT. Clean the crt face, graticule mask, external graticule, filter, and bezel with a soft, lint-free cloth dampened with mild detergent and water. Repeat with a cloth dampened with water only. Avoid hard rubbing when cleaning the painted side of the external graticule to prevent dislodging the markings.

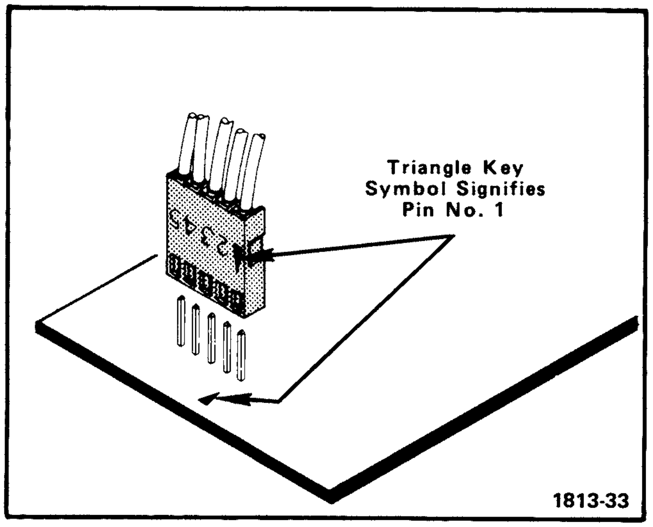


Fig. 7-1. Multi-pin connector.

Lubrication

The reliability of potentiometers, rotary switches, and other moving parts can be maintained if they are kept properly lubricated. Use a cleaning-type lubricant on switch contacts and a heavier grease on switch detents. Lubricate non-sealed potentiometers with a lubricant that does not affect the electrical characteristics. The potentiometer lubricant can also be used on shaft bushings. Do not over-lubricate.

A kit containing the necessary lubricants and instructions may be ordered from Tektronix, Inc. Order Tektronix Part Number 003-0342-02.

Transistor and Integrated Circuit Checks

Periodic transistor and integrated circuit checks are not recommended. The best performance check for these devices is actual operation of the instrument. Performance of the circuit is thoroughly checked by the performance check. Any sub-standard transistors or integrated circuits will usually be detected at that time.

Recalibration

The length of time between recalibrations depends on the amount of use the instrument receives, the nature of the environment, and the change in performance when some components are replaced.

In general, a partial recalibration is necessary if the components replaced affect instrument calibration. Complete recalibration is recommended if the instrument is not operating at its full capability, or if the crt or power transformer, T9400, is replaced. To ensure correct and accurate instrument operation, the instrument performance should be checked at regular intervals; for example, after 1000 hours of operation if used continuously or every 6 months if used infrequently.

The Performance Check is Section 5 and Readjustment Procedure (calibration) is Section 8.

TROUBLESHOOTING

Troubleshooting covers a very large number of items, from determining a trouble exists to the isolation of the specific component responsible. This Instruction Manual contains many troubleshooting aids. Description of available troubleshooting aids plus a troubleshooting procedure follow.

Troubleshooting Aids

Theory of Operation. Section 9 describes circuit operating theory. Used in conjunction with the schematics, test point waveforms, and block diagrams, the information provided in the Theory of Operation section is helpful when analyzing circuit operation.

Diagrams. Circuit diagrams are given on the foldout pages in Section 11. The circuit number and electrical value of each component in this instrument are shown on the diagrams, along with important waveforms.

Circuit Boards. The circuit boards used in the 1480-Series instrument are outlined by a heavy black line on the schematic diagrams. Circuit board illustrations are provided on the back of the foldout pages that precede the relevant diagrams. The assembly number assigned to the circuit boards is an abbreviated method for identifying the boards. Figs. 7-2 and 7-3 show the physical location of the boards along with the assembly numbers for both cabinet and rackmount models.

Each circuit board is illustrated in the Diagrams & Parts Location section. For example, refer to the Vertical Amplifier board which is illustrated on the back of the Block Diagram fold-out page.

Circuit numbers are assigned on a grid system. The upper left corner of this board has been assigned numbers around 1000. Proceeding from left to right, the numbers increase toward 1900. From left to right across the bottom of the board, the numbers increase from around 1090 to 1999. Using this method, the physical location of each component is readily determined.

Wire Color Code. All insulated wires used for interconnection in the instrument are color-coded to facilitate tracing a wire from one point to another.

Power Cord Conductor Identification

Conductor	Color	Alternate Color
Ungrounded (Line)	Brown	Black
Grounded (Neutral)	Blue	White
Grounding (Earthing)	Green-Yellow	Green-Yellow

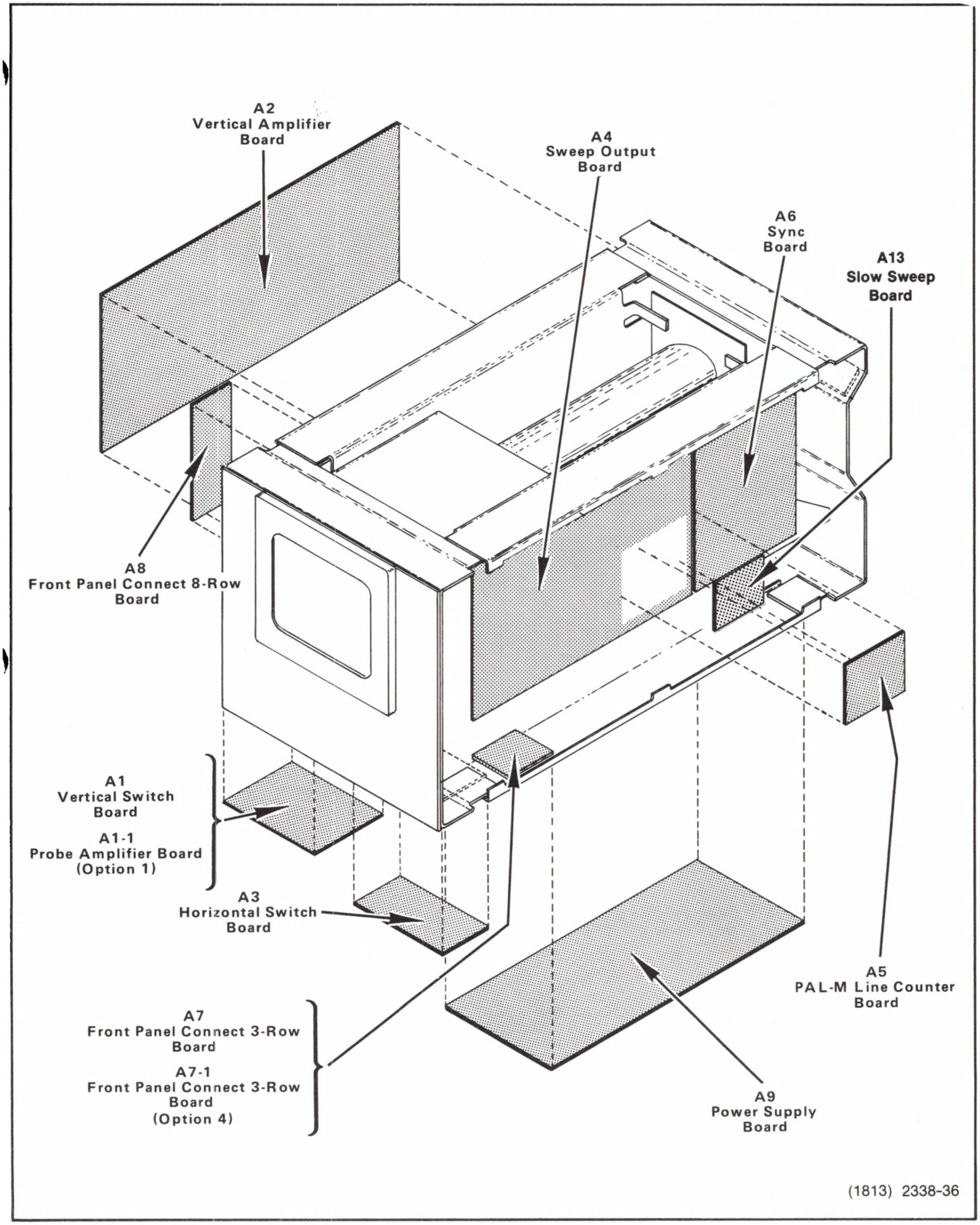

A2
Vertical Amplifier
Board
A4
Sweep Output
Board
A6
Sync
Board
A13
Slow Sweep
Board
A8
Front Panel Connect 8-Row
Board
A1
Vertical Switch
Board
A1-1
Probe Amplifier Board
(Option 1)
A3
Horizontal Switch
Board
A5
PAL-M Line Counter
Board
A7
Front Panel Connect 3-Row
Board
A7-1
Front Panel Connect 3-Row
Board
(Option 4)
A9
Power Supply
Board
(1813) 2338-36

Fig. 7-2. Location of circuit boards in a 1480-Series cabinet model.

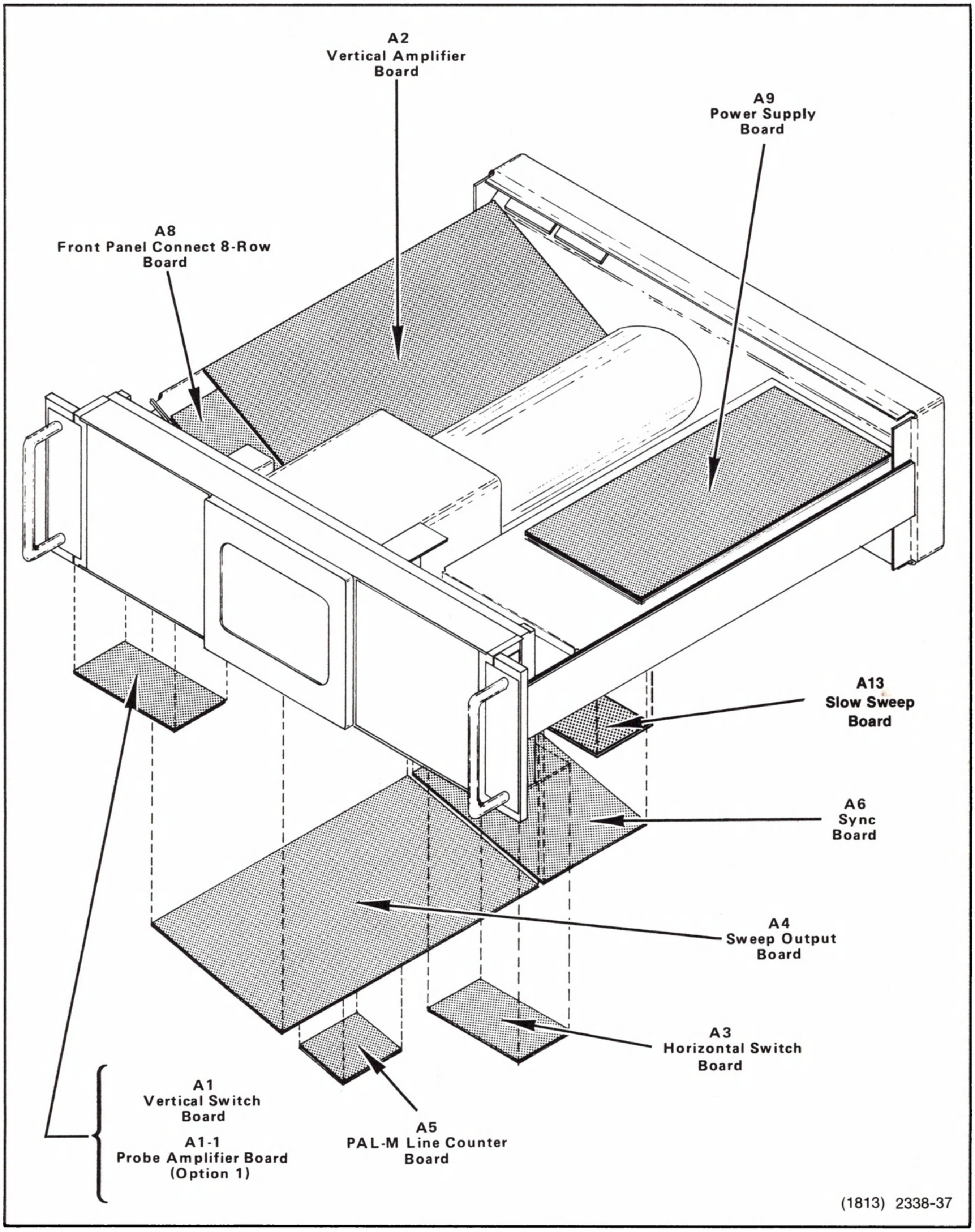

A2
Vertical Amplifier
Board
A9
Power Supply
Board
A8
Front Panel Connect 8-Row
Board
A13
Slow Sweep
Board
A6
Sync
Board
A4
Sweep Output
Board
A3
Horizontal Switch
Board
A1
Vertical Switch
Board
A1-1
Probe Amplifier Board
(Option 1)
A5
PAL-M Line Counter
Board
(1813) 2338-37

Fig. 7-3. Location of circuit boards in the 1480-Series rackmount.

Resistor Identification. Resistors used in this instrument either follow the EIA color code (see Fig. 7-4) or have the value imprinted on the resistor body.

Capacitor Markings. The capacitance value of a common disc capacitor or small electrolytic is marked in microfarads on the side of the component body. The white ceramic capacitors used in the instrument are color-coded in picofarads using a modified EIA code (see Fig. 7-4). The "tear drop" capacitors are color-coded in microfarads using a modified EIA code, with the dot indicating both temperature and positive (+) side. See Fig. 7-5.

Transistor and Integrated Circuit Lead Configurations. Figure 7-6 illustrates the lead configurations for the socket-mounted transistors, field effect transistors (FET's) and Integrated Circuits (IC's) used in the instrument.

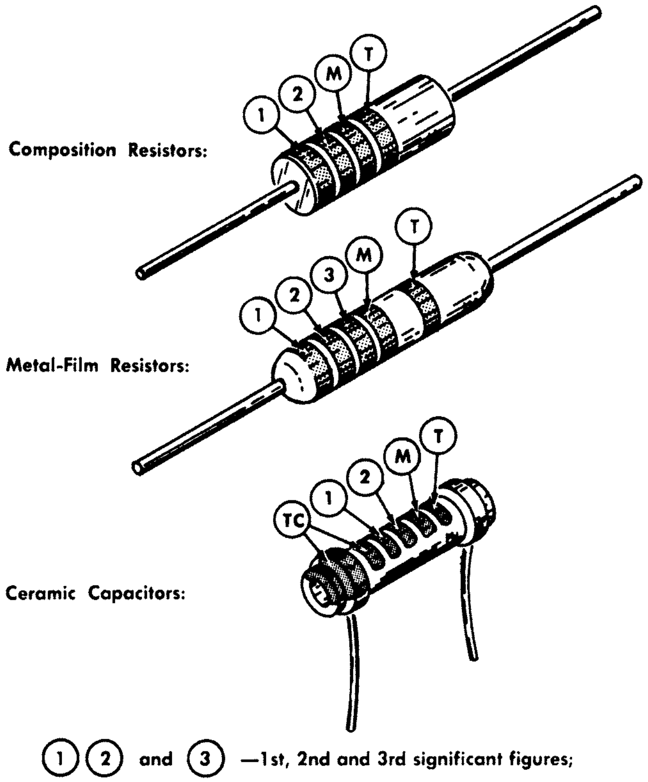
Troubleshooting Requirements

In order to perform the troubleshooting procedure that follows, several items are required.

1. A source of composite video, for the color standard(s) employed in the particular 1480-Series Waveform Monitor.

2. A test oscilloscope, similar to the one specified in the equipment required list in Sections 5 and 8.

3. An accurate dc voltmeter and ohmmeter, can be a multimeter.


Composition Resistors:
Metal-Film Resistors:
Ceramic Capacitors:
1
2
3
M
T
TC
① ② and ③ —1st, 2nd and 3rd significant figures;
Ⓜ —multiplier; Ⓣ —tolerance;
ⓉⒸ —temperature coefficient.

Resistor and Capacitor Color Code

Color	Significant Figures	Multiplier Resistors	Multiplier Capacitors	Tolerance Resistors	Tolerance Capacitors
Silver	---	10^{-2}	---	±10%	---
Gold	---	10^{-1}	---	±5%	---
Black	0	1	1	---	±20% or 2 pF*
Brown	1	10	10	±1%	±1% or 0.1 pF*
Red	2	10^{2}	10^{2}	±2%	±2%
Orange	3	10^{3}	10^{3}	±3%	±3%
Yellow	4	10^{4}	10^{4}	±4%	+100% −0%
Green	5	10^{5}	10^{5}	±0.5%	±5% or 0.5 pF*
Blue	6	10^{6}	10^{6}	---	---
Violet	7	---	---	---	---
Gray	8	---	10^{-2}	---	+80% −20% or 0.25 pF*
White	9	---	10^{-1}	---	±10% or 1 pF*
(none)	---	---	---	±20%	±10% or 1 pF*

*For capacitance of 10 pF or less.

NOTE: Ⓣ and/or ⓉⒸ color code for capacitors depends upon manufacturer and capacitor type. May not be present in some cases.

Fig. 7-4. Resistor and ceramic capacitor color code.

Rated Voltage VDC 25°C	Color	CODE FOR CAPACITANCE IN PICOFARADS		
		1st Figure	2nd Figure	Multiplier—pF
4	Black	0	0	None
6	Brown	1	1	X 10
10	Red	2	2	X 10^2
15	Orange	3	3	X 10^3
20	Yellow	4	4	X 10^4
25	Green	5	5	X 10^5
35	Blue	6	6	X 10^6
50	Violet	7	7	X 10^7
	Gray	8	8	
3	White	9	9	

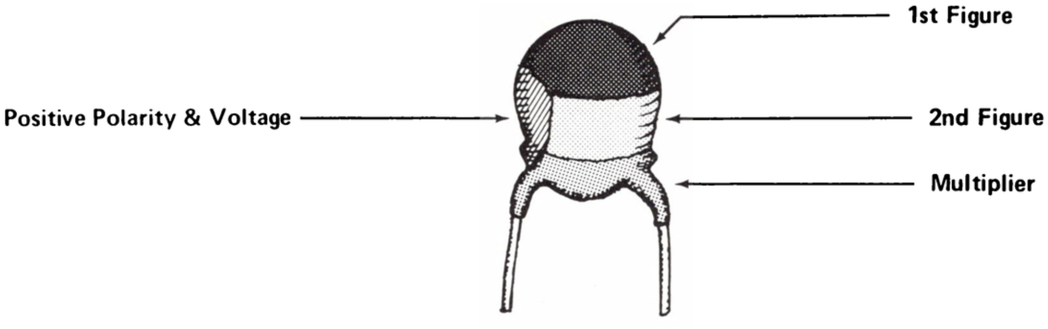


Fig. 7-5. Color code used on dipped tantalum "tear drop" capacitors.

NOTE

Do not attempt to make any adjustment when troubleshooting unless performing all or part of the Readjustment Procedure is planned.

Troubleshooting Procedure

This procedure is arranged in a sequence that isolates the simple trouble possiblities first.

1. Check Control Settings. Incorrect control settings or wrong internal jumper positions can indicate a trouble that does not exist. If there is any question about the correct function or operation of any control or jumper, refer to the Operating Instructions and "Service" Installation sections.

2. Check Associated Equipment. Before troubleshooting the instrument, check that the applied signal is correct and properly connected. Check that the probe (option 1), if used, is not defective.

3. Isolate Trouble to a Circuit. If the 1480-Series instrument is at fault, isolate the trouble to a circuit by noticing the trouble symptoms. This can be accomplished by using the front-panel controls and observing the crt display to identify the nature of the trouble. Then, use steps 4 through 6 to isolate the trouble to the probable cause, such as a defective component or connection. For example, the instrument operates normally in all positions of the INPUT switch except the PROBE position. The next step is to check the PROBE position of the switch and associated circuitry.

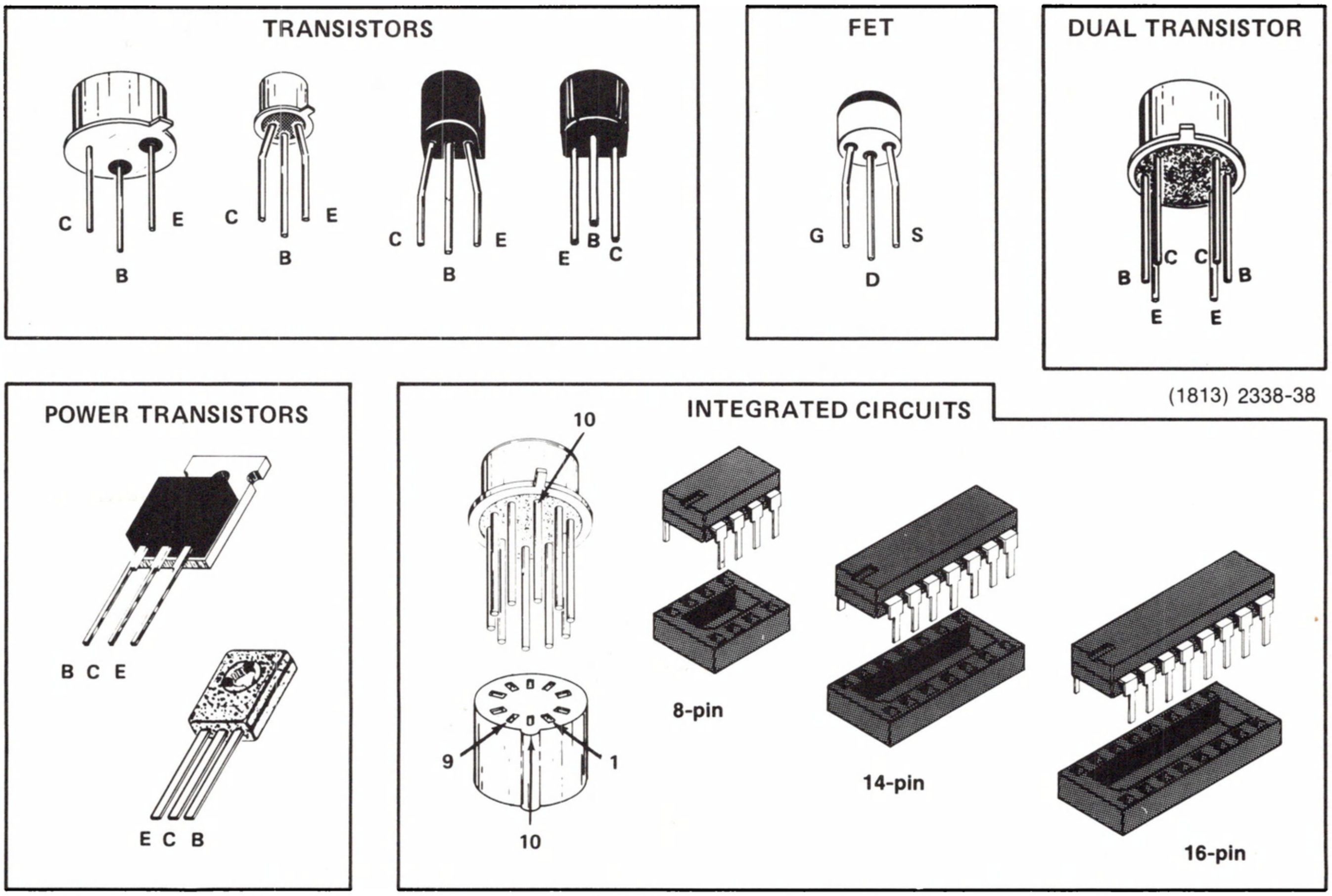

TRANSISTORS
C
E
B
C
E
B
C
E
B
E
B
C
FET
G
S
D
DUAL TRANSISTOR
B
C
C
B
E
E
POWER TRANSISTORS
B C E
E C B
INTEGRATED CIRCUITS
10
9
1
10
8-pin
14-pin
16-pin
(1813) 2338-38

Fig. 7-6. Semiconductor basing diagrams.

WARNING

Dangerous potentials are present in this instrument. Observe all warnings printed on the instrument.

CAUTION

Because of component density on circuit boards, care should be taken with meter leads and probe tips. Accidental shorts can cause abnormal voltages or transients that may destroy components. "Ground lugs" are not always at ground potential. Check the diagrams before using such connections as ground for meter prods or oscilloscope probes.

WARNING

Many transistor cases are elevated, some may be elevated to +140 V.

CAUTION

Do not ground transistor cases, many are elevated to power-supply potential.

4. Visual Check. Visually check the portion of the instrument in which the trouble is suspected. Some troubles can be located by checking for broken wires, loosely-seated transistors, loose-fitting connectors, damaged components, or damaged circuit boards.

5. Check Voltages and Waveforms. Often the defective component or stage can be located by checking for the correct voltage or waveform in the circuit. Typical waveforms are given near the diagrams. To obtain operating conditions similar to those used to take these waveforms, refer to the instructions at the start of the Diagrams section.

6. Check Individual Components. When you have isolated the trouble to one circuit or stage, the next step is to isolate the trouble to one component or part. Components that are soldered in place are best checked by disconnecting one end to isolate the measurement from the effects of surrounding circuitry. The following methods are provided for checking individual electrical components in the instrument.

a. Transistors. The best check of transistor operation is actual performance under operating conditions. If a transistor is suspected of being defective, it can be checked by substituting a new component or one which has been checked previously. However, be sure that the circuit conditions are not such that a replacement transistor might also be damaged.

b. Integrated Circuits. Integrated circuits should not be replaced unless they are actually defective. The best method for checking these devices is by direct substitution with a new component or one which is known to be good. Be sure that circuit conditions are not such that a replacement component might be damaged.

c. Diodes. A diode can be checked for an open or shorted condition by measuring the resistance between terminals. Use an ohmmeter (set to the medium scale to keep from damaging the diode) for measuring the diode resistance. The resistance should be very high in one direction and very low when the ohmmeter leads are reversed.

d. Resistors. Resistors can be checked with an ohmmeter. Check the Replaceable Electrical Parts list for the tolerance of the resistors used in the instrument. Resistors normally should not be replaced unless the measured value varies widely from the specified value.

e. Inductors & Switch Contacts. Check for an open circuit (that should normally be closed) by checking continuity with an ohmmeter.

f. Capacitors. A leaky or shorted capacitor can be detected by checking the resistance with an ohmmeter. Do not exceed the voltage rating of the capacitor. An open capacitor can best be detected with a capacitance meter or by checking whether the capacitance passes ac signals.

CORRECTIVE MAINTENANCE

Corrective maintenance consists of component replacement and instrument repair. Special techniques required to replace components in this instrument are given here.

Soldering Techniques

WARNING

Disconnect the instrument from the power source before soldering.

Reliability and optimum performance of this instrument may be compromised if proper soldering techniques are not used when repairing or replacing parts. Soldering techniques that apply to maintenance of precision electronic equipment should be used when working on this instrument. Use only 60/40 rosin-core, electronic grade solder. The choice of soldering iron is determined by the repair to made. When soldering on circuit boards, use a 15- to 25-watt pencil-type soldering iron with a 1/8-inch wide, wedge-shaped tip. Keep the tip properly tinned for best heat transfer to the solder joint. A higher wattage soldering iron may separate the etched wiring from the base material. Avoid excessive heat; apply only enough heat to remove the component or to make a good solder joint. Use only enough solder to make a firm solder joint. Use a desoldering tool or other device when it is necessary to remove excess solder.

The pencil-type soldering iron used on the circuit boards should be used for soldering to switch terminals, potentiometers, or metal terminals mounted in plastic holders. For ground lugs that are connected to the chassis, or other metal terminals that are large, heat-radiating surfaces, use a high-wattage-rating soldering iron with a larger tip.

After soldering is completed, clean the area around the solder connection with a flux-remover solvent. Be careful not to remove any information printed in the area.

Location Guide for Replacing Parts

The exploded-view drawings associated with the Replaceable Mechanical Parts list (located at the rear of the manual) are helpful in the removal or disassembly of individual components or subassemblies. Circuit board illustrations are provided on the backs of foldout pages in the Diagrams section of this manual.

WARNING

Disconnect the instrument from the power source before replacing components.

Circuit Board Replacement

If a circuit board is damaged beyond repair, the entire assembly, including all soldered-on components, can be replaced. Tektronix part numbers are given in the Replaceable Electrical Parts list.

Most of the circuit boards in this instrument are mounted on the chassis. Multi-pin connectors are used for interconnection with other circuits. Use the following procedure to remove circuit boards.

Chassis-Mounted Boards.

1. Disconnect the multi-pin connectors from the board. Note the order of these connectors so they can be correctly replaced. Disconnect any other connectors that are used for interconnection to other circuits.

2. Remove the securing screws.

3. Remove the board.

4. To replace the board, reverse the order of removal. Match the triangle key symbol on the multi-pin connectors to the same symbols on the board.

Loop-Thru Boards. These boards are mounted and soldered directly to the center pins of the bnc connectors.

1. Unsolder the coaxial-cable signal lead from the board.

2. Desolder the bnc connector pins that protrude through the board.

3. Remove the board.

4. For replacement, resolder the bnc connector pins to the board and resolder coaxial-cable leads to the board.

Vertical and Horizontal Switch Boards.

1. Disconnect the multi-pin connectors from the board.

2. Remove the securing screws. To obtain access to these screws in the 1480C-Series (cabinet model) instruments, remove the eight flat-head screws that hold the front assembly to the chassis. Move the front frame-assembly outward sufficiently to reach the board securing screws.

3. Remove the board with attached pushbutton assemblies.

4. Install the board by reversing the order of removal.

Pin Connector Replacements

Circuit board pins, end-lead pin connectors, and multi-pin connectors are used to interconnect the circuit boards, and connect power transistors to circuit boards in this instrument.

Circuit Board Pins.

NOTE

A circuit-board pin replacement kit including necessary tools, instructions and replacement pins is available from Tektronix, Inc. Order Tektronix Part No. 040-0542-00.

To replace a pin that is mounted on a circuit board, first disconnect the multi-pin connector. Then, unsolder the damaged pin and pull it out of the circuit board with a pair of pliers. Be careful not to damage the etched wiring on the board with too much heat or force. Ream out the hole in the circuit board with a 0.031-inch drill. Press the new pin into the hole in the circuit board. Position the pin in the same manner as the old pin. Then, solder the pin on both sides of the circuit board.

End-Lead Pin Connectors. End-lead pin connectors are used at the ends of the wire leads that mate with circuit board pins and power-transistor leads. When several end-lead pin connectors are mounted in a plastic holder, this arrangement is called a multi-pin connector. Table 7-1 lists three basic sizes of end-lead pin connectors for replacement use in the instrument.

Table 7-1

END-LEAD PIN CONNECTORS

Description	Tektronix Part. No.
Used with 0.100-inch pin spacing connector holder:	
For 22 to 26 AWG wire and 50 Ω or 75 Ω subminiature coaxial cable braid and center conductor	131-0707-00
Used with 0.150-inch pin spacing connector holder:	
For 22 to 26 AWG wire and 50 Ω or 75 Ω subminiature coaxial cable braid and center conductor	131-0621-00
For 18 AWG wire and large coaxial cable braid	131-0792-00

To replace a damaged end-lead pin connector, remove the old pin connector by cutting the connector where the bare (stripped portion) wire is clamped. By doing this, you can avoid making the wire too short. Then, pull the wire out of the remaining attached portion of the connector. Cut the excess material from the replacement connector. Clamp the replacement connector securely to the lead and insert the connector in its holder.

Semiconductor Replacement

Semiconductors should not be replaced unless they are actually defective.

CAUTION

The POWER switch must be turned off before removing or replacing semiconductors.

If the semiconductors are removed from their sockets during routine maintenance, return them to their original sockets. Unnecessary replacement of semiconductors may affect the calibration of this instrument. When semiconductors are replaced, check the operation of the instrument by performing all or part of the Performance Verification Procedure (Section 5).

Figure 7-6 is a semiconductor basing diagram for all of the semiconductor types used in the 1480-Series Waveform Monitors.

Replacement semiconductors should be of the original type or a direct replacement. Some plastic-cased transistors have lead configurations that do not agree with those shown here. If a replacement transistor is made by a different manufacturer than the original, check the manufacturer's diagram for correct basing. All transistor sockets in this instrument are wired for the standard basing used for metal-cased transistors. Power transistors that are mounted on the chassis use silicone grease to increase heat transfer. Replace the silicone grease when replacing these transistors.

WARNING

Handle silicone grease with care. Avoid getting silicone grease in the eyes. Wash hands thoroughly after use.

An extracting tool should be used to remove the 8-, 14-, and 16-pin integrated circuits to prevent damage to the pins. This tool is available from Tektronix, Inc. Order Tektronix Part No. 003-0619-00. If an extracting tool is not available when removing one of these integrated circuits, pull slowly and evenly on both ends of the device. Try to avoid having one end of the integrated circuit disengage from the socket before the other, as this may damage the pins.

Cathode-Ray Tube Replacement

WARNING

Use care when handling the crt. Protective clothing and safety glasses should be used. Avoid striking it on any object that might cause it to crack or implode. When storing a crt, place it in a protective carton or set it face down in a protected location on a smooth surface with a soft mat under the faceplate to protect it from scratches.

Removal.

1. Take off the rear-panel crt hole-cover.

2. Remove the crt-base socket from the rear of the crt.

3. Loosen the neck-clamp screw (see Fig. 7-7).

4. Disconnect the deflection-plate connectors. Be careful that you do not bend the deflection plate pins or pin connectors.

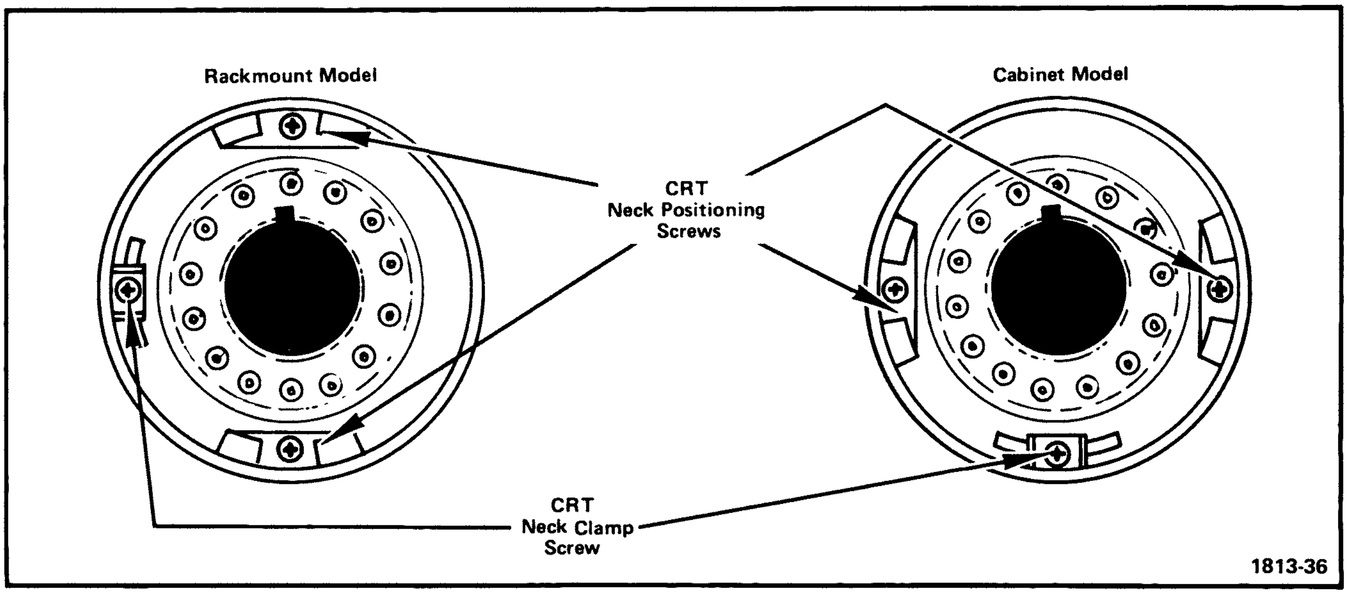


Fig. 7-7. Neck clamp and neck positioning screw locations.

5. Disconnect the crt anode lead where it connects to the high voltage connector outside of the crt shield. Ground the crt anode lead to the chassis to "bleed" off any stored charge.

6. Remove the front-panel bezel mounting nuts. Remove the bezel, rubber washers, filter, external graticule, and the gray plastic graticule-mask.

7. Hold one hand on the crt faceplate and push on the crt base with the other. As the crt starts moving out of the shield, grasp the crt firmly. If the crt does not budge, loosen the crt-neck positioning screws (see Fig. 7-7) slightly so the crt can be moved around. Then push on the crt base while moving the base gently from side to side. Guide the anode lead through the hole in the crt shield as the crt is removed.

Replacement.

1. Clean the graticule-mask, external graticule, filter, and bezel with a soft, lint-free cloth dampened with mild detergent and water. Dry with a soft lint-free cloth.

2. Insert the crt in the shield. Guide the anode lead through the hole in the crt shield.

3. Align the crt faceplate with the front-panel mask. Keep flush with the mask while tightening the crt-neck clamp and positioning screws. Do not over tighten neck-clamp screws.

4. Replace the crt base socket.

5. Install the graticule mask, external graticule, filter and bezel.

6. Reconnect the anode lead and the deflection-plate leads. Be careful not to bend the deflection-plate pins or pin connectors.

7. Replace the rear-panel crt hole-cover.

8. Perform a complete instrument readjustment; all instrument calibration is based on the crt operating parameters, which vary slightly from crt to crt.

Removal of Orthogonality Coil, L9350

This coil is located just behind the crt deflection-plate pins inside the shield. Two self-tapping screws hold the coil in its proper position.

Removal.

1. Remove the crt, using the crt removal procedure.

2. Disconnect the orthogonality coil multi-pin connector from the power-supply board.

3. Remove the two self-tapping screws that go through the crt shield to the coil form. For rackmount models—the screws are accessible from the bottom of the instrument. For cabinet models—you will need to use an offset Phillips screwdrive to reach the screws that are located on the left side (looking from the front) of the crt shield.

4. Remove the coil through the crt shield.

Replacement. Install the replacement coil by reversing the order of removal. Use the crt replacement procedure to install the crt.

Removal of Trace Rotation Coil L9650

This coil snaps into the square mounting-holes located in the rectangular portion of the crt shield.

Removal.

1. Remove the crt, using the removal procedure.

2. Disconnect the trace-rotation coil multi-pin connector from the front-panel 8-row interconnect board.

3. Remove the front plastic-support for the crt. There are four self-tapping screws holding this support; one screw per side of the front crt-shield. For a rackmount model, use an offset Phillips screwdriver to loosen the hard-to-reach screws. For a cabinet model, remove the vertical amplifier and sweep output boards to reach two of the screws. Direct access to the screw at the bottom of the shield is blocked by the power transformer, but it is possible to use a long-shank, slender screwdriver to reach the screw at an angle and remove it. After removing the four self-tapping screws, remove the crt support through the front of the crt shield.

4. Note the position of the trace-rotation coil and the routing of its leads. Unsnap the trace-rotation coil from the shield and remove through the front of the shield.

Replacement. Install the replacement trace-rotation coil by reversing the order of removal. Follow the crt replacement procedure when installing the crt.

Removal of Power Transformer T9400

Replace the power transformer only with a direct replacement transformer. Tag the soldered-on-leads with corresponding terminal numbers to aid in connecting the new transformer. The removal and replacement procedure is as follows:

WARNING

Disconnect power cord before removing power transformer.

1. For cabinet-model instruments; remove the power-supply board. For rackmount models; remove the transformer multi-pin connectors from the power-supply board and push them back through the hole in the chassis.

2. Unsolder the black-red on gray and brown-white on gray wires from the transformer primary terminals.

3. Unsolder the black (transformer shield) wire from the chassis ground-lug.

4. Remove the four bolts that mount the transformer in the instrument. For rackmount models; loosen the two screws in the transformer bracket.

5. Install the replacement transformer and check the performance of the complete instrument, using the Performance Verification Procedure in Section 5.

Lamp Replacement

To replace any of the lamps used in the 1480-Series instruments, it is first necessary to remove the front-panel bezel mounting-nuts, bezel, rubber washers, filter, external graticule, and graticule mask.

External Graticule Lamps. These lamps have a groove around their base that holds them in their spring-loaded sockets. One method for removing a lamp is to push a tight-fitting rubber sleeve or spaghetti over the bulb and pull the lamp straight out. Another method is to use an L-shaped wire made from a paper clip that can be inserted through the widest slot in the socket to remove the lamp. A third method is to use the IC extracting tool described earlier. Push the replacement lamp straight into its socket until the lamp groove is seated within the socket.

Internal Graticule Lamps. These miniature lamps are located above the crt faceplate, and are mounted in a plastic light-pipe assembly. To remove a lamp, unsolder the wires attached to the lamp and solder these wires to the replacement lamp.

Indicator Lamps. These lamps are equipped with long wire-leads and are held in position in the front panel. To remove a lamp, disconnect the leads and remove the front panel, using the following procedure that is applicable to your instrument:

For cabinet models—Remove all the knobs using 1/16-inch and 0.050-inch hex wrenches. Remove the two screws located near the lower left and right corners of the front panel. Remove the POWER switch mounting-nut, using a 12-sided 5/8-inch nutdriver; remove the washer. Remove the INTENSITY switch mounting-nut, using a 5/16-inch nutdriver; remove the washer. Remove the front panel and the lamp. Install the replacement lamp and all removed parts.

For rackmount models—There are two front panels; left and right.

To replace a left front-panel indicator lamp, remove all the left front-panel knobs, using a 1/16-inch hex wrench. Remove the POWER switch mounting-nut, using a 12-sided 5/8-inch nutdriver; remove the washer. Remove the RESPONSE switch mounting-nut, using a 7/16-inch nutdriver; remove the washer. Remove the left front-panel and defective lamp. Install the replacement lamp and all removed parts.

To replace a right front-panel indicator lamp, remove all the right front-panel knobs, using a 1/16-inch and 0.050-inch hex wrench. Remove the LINE SELECTOR switch mounting-nut, using a 7/16-inch nutdriver; remove the washer. Remove the right front-panel and defective lamp. Install the replacement lamp and all removed parts.

Removal of Front Panel Controls

Pushbutton Switches: Refer to the Vertical and Horizontal Switch board-removal procedure for removing the boards. Then, replace the switch by desoldering the switch terminals and removing the switch from the board. Install the replacement switch in the same position as the old one so that the pushbuttons are aligned with their respective holes in the front panel and do not bind.

Front-Panel Control and POWER Switch: Make a sketch of the terminals and show the color-code of the wires so these can be properly reconnected on the replacement part. For the hard-to-see controls on the cabinet model, you will have to make the sketch after the front-frame assembly is separated from the chassis. This is accomplished by removing eight flat-head screws and the multi-pin connectors. A control can be removed by removing the knob(s), mounting nut, and washer; unsolder the wires. The POWER switch is removed by unsoldering the wires, removing the mounting nut and washer.

Front-Panel Screwdriver Adjustments: Make a sketch of the terminals and color-coded wires. Unsolder the wires and use a 1/16-inch wrench to remove the control.

Removal of 4X Multiplier

Disconnect the high-voltage lead at the crt anode-lead connector. Unsolder the wire attached to the 4X Multiplier terminal. For rackmount models, use an offset Phillips screwdriver to remove the three mounting screws. For cabinet models, remove the vertical amplifier board to reach the 4X Multiplier mounting screws. For all models—when installing the replacement 4X Multiplier, be sure to make a smooth-surface solder joint, then coat the exposed solder connection with corona dope.

REPLACEMENT PARTS

All replacement parts for the 1480-Series may be obtained through your local Tektronix, Inc. Field Office or representative. Many of the standard electronic components used in this instrument should be available locally. This option should be looked into before ordering from Tektronix, Inc. to reduce the time required to repair the instrument. Check the Replaceable Electrical Parts list for a complete description of the part before ordering.

Some of the components used in this instrument are designated as special parts. These components are selected by, or manufactured by Tektronix, Inc., to meet specific performance requirements. Special components are identified in the Replaceable Electrical Parts list by a note in the column headed "Description".

Ordering Replacement Parts

When ordering replacement parts from Tektronix, Inc., please include the following information:

1. Instrument Type.

2. Instrument Serial Number.

3. Circuit number and description, as they appear in the Replaceable Electrical Parts list.

4. Tektronix, Inc. part number.

Mechanical Parts

Information required for replacement of, or ordering of mechanical parts can be found Sections 11 and 12.

Instrument Repackaging

The 1480-Series shipping carton provides maximum protection during shipment. If reshipment is necessary, repackage the instrument in its original carton to minimize danger of damage in transit. Repackaging illustrations are provided in (Part 1, Section 1, Operating Information) showing how to repackage the shipment.

ADJUSTMENT PROCEDURE

This section is intended to return the 1480-Series Waveform Monitor to operation within specification. It may be used after repair, in part or all, or as a routine calibration procedure. It is designed to allow the use of as little or as much adjustment as necessary, EXCEPT FOR THE POWER SUPPLY ADJUSTMENT: Power supply adjustments affect the operation of the entire instrument and when the power supply is readjusted even slightly, the entire instrument must be readjusted to ensure operation within specification.

Remember to always perform the Performance Check Procedure (Section 5) following adjustment.

1480-Series Waveform Monitors have two basic graticule scales. One for use with NTSC standards is referred to in this procedure as the NTSC graticule. The other (scaled for use with PAL standards) is identified as the CCIR graticule. The horizontal time scale is the same for both because the 1480-Series time base in in microseconds (μs), rather than increments of line time. The major difference lies in the vertical scales; 0 to 1 volt for the CCIR graticule and −40 to +100 IRE for the NTSC graticule. Where amplitude measurements are stated in this procedure, the results are given in both mV and IRE to accomodate both graticules.

Through most of this procedure, the instrument is operating in a 75 Ω impedance system. A 75 Ω end-line termination should be used on the open side of the loop-thru connector pair when termination is required.

Front- and rear-panel control and connector names on the 1480-Series instrument under test are capitalized; example: VOLTS FULL SCALE. Control and connector names on test equipment have only the first letter capitalized; example: Time/Div.

TEST EQUIPMENT

The test equipment listed here was used in preparing this procedure. The measurement capabilities described are the minimum required to verify instrument performance. Each piece of test equipment is assumed to be operating within its stated specifications. If alternative equipment is used, it must meet or exceed these requirements.

Some additional test equipment is required to check the performance of optional circuitry. This equipment is listed at the beginning of the optional step to be performed. These steps begin at the end of the main adjustment procedure. If this instrument contains options other than 2, 3, or 6, be sure to check the "Additional Equipment Required" list for that option.

1. Video Signal Source

Capable of generating color bars, composite sync, and modulated staircase test signals.

Standard	Recommended Instrument
NTSC	TEKTRONIX 140
PAL	TEKTRONIX 145
PAL-M	TEKTRONIX 145-M

2. Digital Voltmeter

Accurate within 0.1% for dc volts from −4500 to +200 V. Example: TEKTRONIX DM 501 with a high-voltage probe (Tektronix Part Number 010-0277-00).

3. Leveled Sine-Wave Generator

Capable of amplitudes from 0.2 volt peak-to-peak to 5 volts peak-to-peak, frequency range from 50 kHz (reference) to 10 MHz. Example: a TEKTRONIX SG 503.

4. Time-Mark Generator

Capable of generating time marks at intervals from 100 ns to 10 μs, with accuracy adjustable to within 1 part in 10^{-7}. Example: a TEKTRONIX 184 (if available), or TEKTRONIX TG 501 (see NOTE following Test Equipment list.

5. Power Module

For powering and housing TEKTRONIX DM 501, TG 501, FG 501, and SG 503 units. (Required if using these units.) TEKTRONIX TM 504.

6. Test Oscilloscope

Dual Time-Base. Range from 50 ns/div to 5 s/div with provisions for a delaying sweep and television triggering.

Differential Comparator. Bandwidth, dc to 30 MHz; minimum deflection factor, 1 mV/div; two channels, capable of differential operation.

Dual-Trace Amplifier. Vertical amplifier independent of the differential comparator. Bandwidth, dc to 30 MHz; minimum deflection factor 5 mV/div.

Example: a TEKTRONIX 7603 with 7B53A Option 5 Dual Time-Base, 7A13 Differential Comparator, and 7A18 Dual-Trace Amplifier.

7. Return Loss Bridge

Tektronix Part Number 015-0149-00.

8. Television Test Signal Generator

Capable of generating 3-step and 4-step RGB/YRGB signals. Example: a TEKTRONIX 067-0601-00 Television Test Signal Generator.

9. 75 Ω Cable

42 inches long. Four each. Tektronix Part Number 012-0074-00.

10. 75 Ω End-Line Termination

Four each, Tektronix Part Number 011-0102-00.

11. 75 Ω Feed-Through Termination

Two each, matched with 0.2%. Supplied as accessories with the return loss bridge (item 8). Tektronix Part Number 011-0103-00.

12. 75 Ω Feed-Through Termination

Two each, Tektronix Part Number 011-0103-02.

13. 50 Ω to 75 Ω Minimum Loss Attenuator

Tektronix Part Number 011-0057-00.

14. Attenuators

2X — Tektronix Part Number 011-0069-02.
5X — Tektronix Part Number 011-0060-02.
10X — Tektronix Part Number 011-0059-02.

15. Bnc Cable Tee-Connector

Tektronix Part Number 067-0525-01.

16. P6101 1X Probe

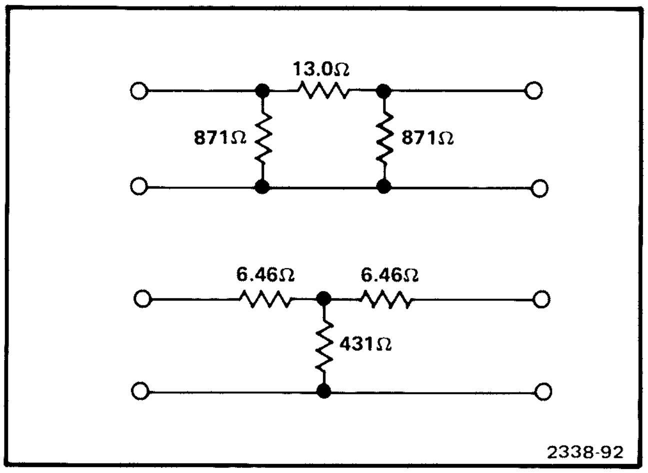
Tektronix Part Number 010-6101-01.

17. P6105 10X Probe

Tektronix Part Number 010-6105-01.

18. 1.5 dB Attenuator

Must be constructed by customer as shown below.



75 Ω 1.5 dB Attenuators

19. Peak-to-Peak Detector Amplifier

Tektronix Part Number 015-0408-00 (Includes one 015-0413-00 P-P Detector Head).

20. Detector Head

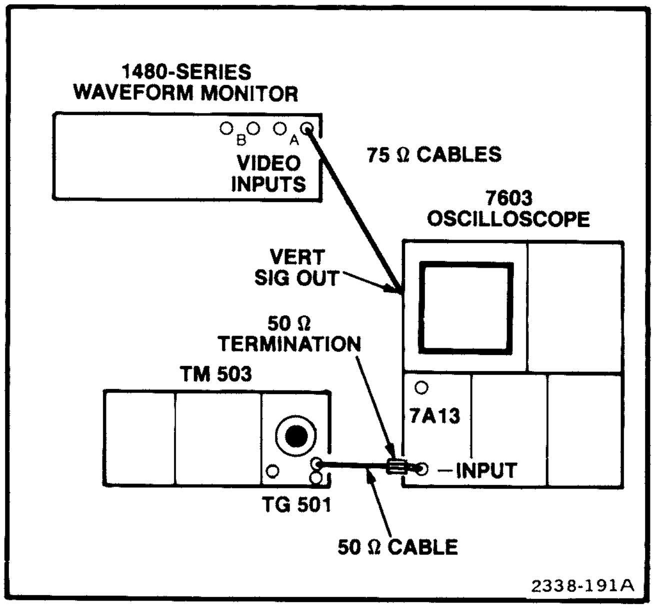
Two each, Tektronix Part Number 015-0413-00 for use with the Tektronix 015-0408-00 Peak-to-Peak Detector (Item 19). One of these is supplied with the 015-0408-00.

NOTE

For stable synchronization of the display when checking or adjusting horizontal timing of the sweep, a negative-going triggering signal must be supplied.

The markers and triggers from the TEKTRONIX TG 501 Time-Mark Generator are positive-going. Inversion of the markers or trigger output is easily accomplished, using test equipment that is normally required for other parts of the Performance Verification Procedure and the Adjustment Procedure.

The positive-going markers (or trigger) from the TG 501 can be coupled through the −Input on the Differential Comparator, where inversion occurs. The resulting negative-going signal is available on the rear panel of the 7603 Oscilloscope at the Vert Sig Out connector. The output amplitude depends directly upon the number of divisions of vertical deflection on the screen of the 7603 Oscilloscope. The 7A13 Differential Comparator unit is capable of handling several screen diameters of signal without excessive distortion, so the output signal is not limited by the 8-division graticule height. Connect the equipment as shown in the illustration accompanying this note.



Equipment connections when using the TG 501 Time-Mark Generator for timing the 1480-Series Waveform Monitor. The 1480 SYNC should be set to INT-DIRECT.

ADJUSTMENT PROCEDURE

Preliminary Setup

Connect the power cord from the 1480-Series under test to the voltage control unit. Set the voltage control unit to the center value of the mains supply range for the 1480-Series Waveform Monitor being readjusted.

NOTE

If the power supplies are adjusted, readjust the entire instrument.

1. Adjust −15 V Supply[1]

a. Connect the dc Voltmeter between ground and the −15 V test point (P6196), and check for −14.85 V to −15.15 V.

b. Adjust R6096 (−15 V Adj.) for −15 V, if out of tolerance. See Fig. 8-1 for test point and adjustment locations.

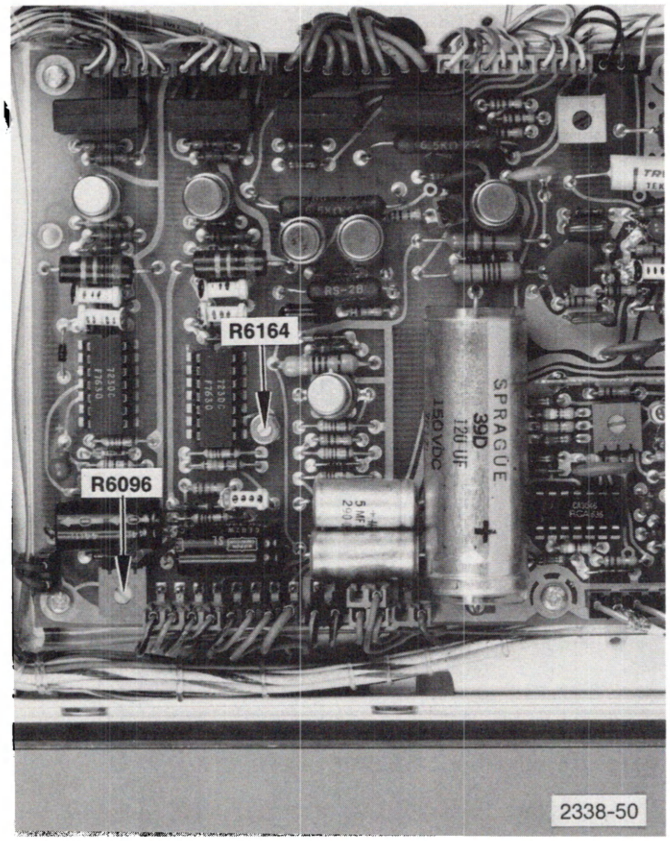


Fig. 8-1. Location of test points and adjustments for power supply.

2. Adjust +15 V Supply[1]

a. Connect the dc voltmeter between ground and the + V test point (P6198), and check for +14.85 V to +15.15 V.

b. Adjust R6164 (+15 V Adj.) for +15 V, if out of tolerance.

3. Check +75 V Supply

a. Connect the dc voltmeter between ground and the +75 V test point (6296).

b. Check for +73.5 V to +76.5 V.

4. Check the +140 V Supply

a. Connect the dc voltmeter between ground and the +140 V test point (P6298).

b. Check for +134.4 V to +145.6 V.

5. Check the +5 V Supply

a. Connect the dc voltmeter between ground and the +5 V test point (6292).

b. Check for +4.7 V to +5.3 V.

6. Check the HV Supply

a. Install the high-voltage probe on the dc voltmeter.

b. Connect the dc voltmeter (high-voltage probe) between ground and the high-voltage test point (TP 6886).

c. Check for −3861 V to −4091 V. See Fig. 8-2.

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[1] Power supply adjustments have some interaction; if one is adjusted the other must be checked. Note that the adjustment of a power supply makes it necessary to readjust the entire 1480-Series Waveform Monitor.

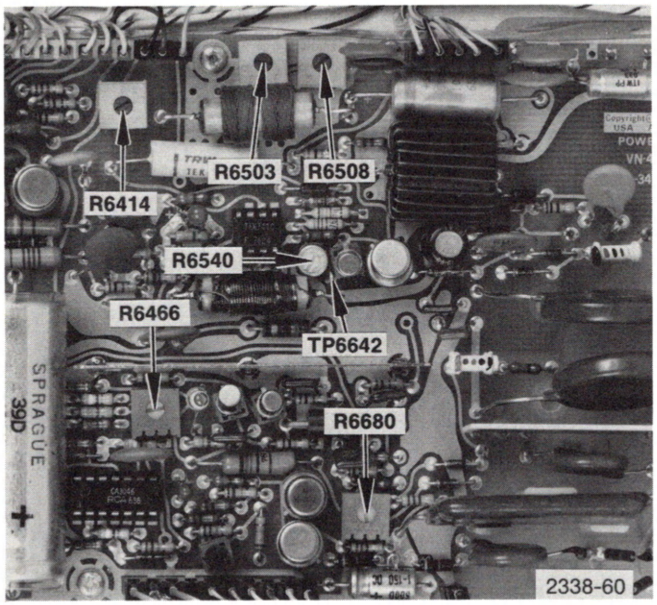

Fig. 8-2. Location of test points and adjustments for crt circuits.

7. Check Power-Supply Ripple and Regulation

a. Connect the dc voltmeter to each of the power-supply test points in Table 8-1.

Table 8-1

Supply	Ripple	Regulation
−15 V	⩽2 mV	±0.15 V
+15 V	⩽2 mV	±0.15 V
+5 V	⩽50 mV	±0.3 V
+75 V	⩽5 mV	±1.5 V
+140 V	⩽10 mV	±5.6 V

b. Using the voltage control unit, vary the mains supply ±10% from range center and check the power supply regulation in accordance with Table 8-1.

c. Connect 1X probe from the test oscilloscope dual-trace amplifier to each of the power supplies listed in Table 8-1.

d. Check power supply ripple according to Table 8-1 while varying the mains supply ±10% from range center with the voltage control unit.

e. Return the voltage control unit to mains center range.

8. Adjust CRT Bias

a. Set the INTENSITY control counterclockwise and the DISPLAY selector to EXT. Adjust R6680 (CRT Bias) until the display is just extinguished. See Fig. 8-2 for location of adjustments and test points.

b. Set the DISPLAY selector to 5 μs/DIV and the INTENSITY control clockwise, and check that time-base retrace is not visible.

9. Adjust Astigmatism

a. Set the INTENSITY control to about "2 o'clock", and adjust R6503 (Astigmatism) and the front-panel FOCUS control for a sharp, well-defined display.

10. Adjust Maximum Intensity

a. Press the LINE SELECTOR DIG pushbutton. Do not adjust the INTENSITY control.

b. Adjust R6466 (Max Intens) for a sharp, well-defined display.

11. Adjust Geometry and Trace Rotation

a. Set the INPUT selector to B, DC CPL'D and adjust TRACE ROTATION for a trace that is level with the center graticule line.

b. Adjust R6508 (Geometry) for best trace alignment with the top and bottom graticule lines; there should be no more than ±1 minor division variance from alignment at top or bottom. For location of R6508, see Fig. 8-2.

12. Adjust Y Axis Alignment

a. Set the INPUT selector to A, DC CPL'D, DISPLAY selector to EXT, and MAGNIFIER to 1 μs/DIV.

b. Position the vertical line to graticule center.

c. Adjust R6414 (Y Axis Align) for 1 minor division or less deviation from exact vertical.

d. Check that the vertical line has 1 minor division or less deviation from exact vertical at the left and right graticule edge.

e. Set the DISPLAY selector to 10 μs/DIV and MAGNIFIER to OFF.

13. Adjust HV Surge Protection

a. Connect the dc voltmeter between ground and TP6642.

b. Adjust R6540 (Surge Protection) for −250 mV. See Fig. 8-2 for location of R6540, TP6642, and TP6886.

WARNING

Making measurements and connections within the High Voltage Power Supply can involve exposure to dangerous voltages. Always turn Power off before making or changing connections.

c. Shut the 1480-Series POWER off.

d. Connect a 5 kΩ potentiometer from pin 4 to pin 7 of U6060 (see Fig. 8-1 for location of U6060). Set the potentiometer to approximately midrange.

e. Connect the dc voltmeter (with hv probe) between ground and TP6886.

f. Turn the 1480-Series POWER switch on.

g. Rotate the 5 kΩ potentiometer until the redundant sound of the high-voltage limiting is heard (high-pitched whine).

h. Check for −4400 V.

i. Shut the 1480-Series POWER switch off.

j. Remove the dc voltmeter connections and the 5 kΩ potentiometer, and turn the 1480-Series POWER switch on.

14. Adjust Gain, VIDEO INPUT A to AUX VIDEO OUT

a. Connect the video signal source to the 1480-Series VIDEO INPUT A connector.

b. Connect the other side of the VIDEO INPUT A loop-thru connector to the + Input of the test oscilliscope differential comparator through one of the matched 75 Ω terminations.

c. Connect the 1480-Series AUX VIDEO OUT connector through the other matched 75 Ω termination to the − Input of the test oscilloscope differential comparator. See Fig. 8-3 for the connections used for this test.

d. Set the test oscilloscope differential comparator for ac coupling on both inputs, and a sensitivity of 20 mV/division.

e. Turn the video signal source chrominance off.

f. Adjust R1348 (Gain Out) for a nulled test oscilloscope display, flat trace. See Fig. 8-6 for location of R1348.

g. Turn the video signal source chrominance on.

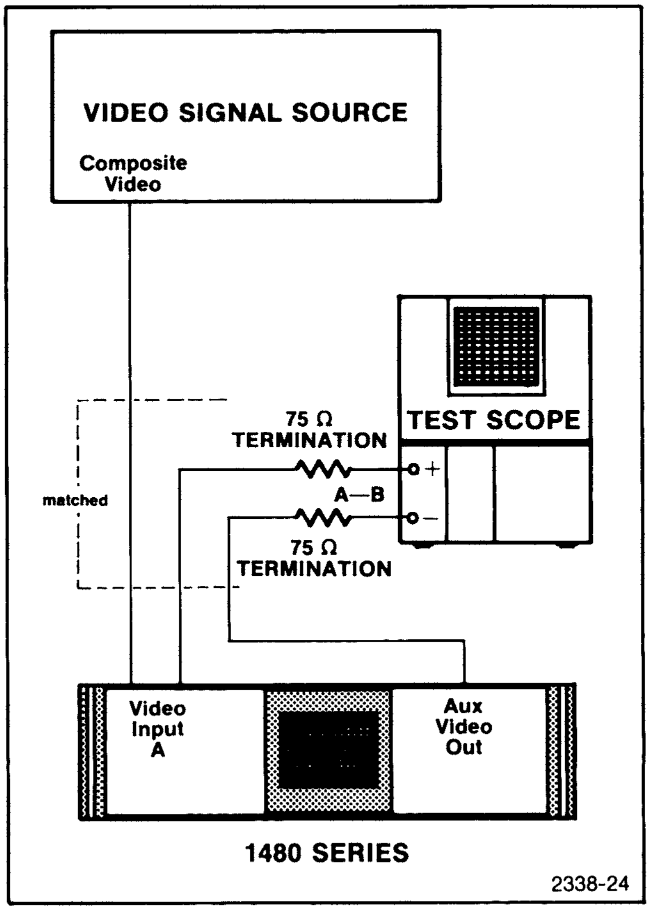

Fig. 8-3. Setup for 1480-Series gain adjustment.

15. Adjust GAIN

a. Press the DC RESTORER SYNC TIP and the CAL pushbuttons.

b. Adjust the front-panel GAIN control for 1-volt or 140 IRE display height.

16. Adjust DC Balance and Centering

a. Set the VERTICAL POSITION control at the approximate center of its range (5 turns from either end).

b. Press the DC RESTORER OFF pushbutton.

c. Adjust R1666 (Cent) until the back porch of the displayed signal is at blanking level. See Fig. 8-4 for location.

d. Press the DC RESTORER FAST and BACK PORCH pushbuttons.

e. Rotate the VERTICAL POSITION control if necessary, to place the back porch of the display at blanking level.

f. Press the DC RESTORER OFF pushbutton and adjust R1125 (DC Bal), until the back porch of the display is at blanking level. See Fig. 8-6.

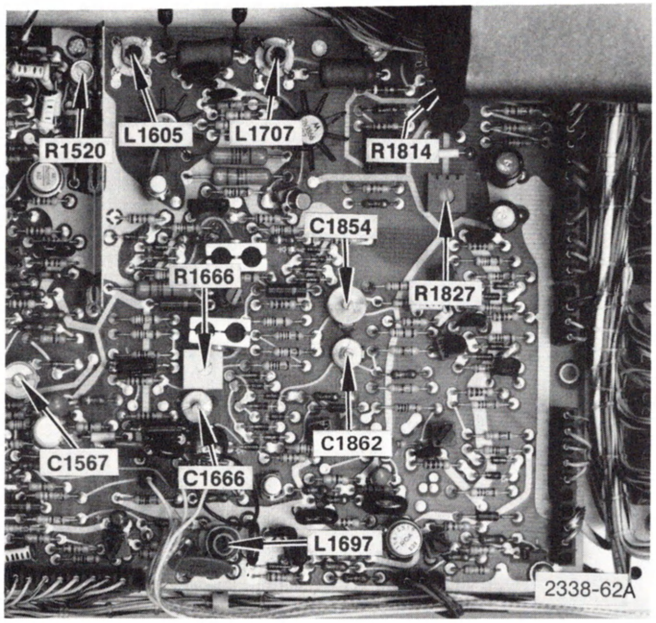

Fig. 8-4. Front half of the Vertical Amplifier circuit board, showing adjustment numbers from 1500 to 1999. For adjustment numbers below 1500 see Fig. 8-6.

g. Repeat until no shift is observed while pressing DC RESTORER FAST and OFF pushbuttons alternately.

h. Set the VOLTS FULL SCALE selector ot 0.2 and rotate the VERTICAL POSITION control until the back porch of the display is a blanking level.

i. Set the VOLTS FULL SCALE selector to 1.0 and adjust R1666 (Cent) Fig. 8-4, for no display shift as the VOLTS FULL SCALE selector is switched between 0.2 and 1.0. Repeat to eliminate the effects of interaction.

17. Adjust AUX VIDEO IN Response Change

a. Connect a color bar test signal from the video signal source to the VIDEO INPUT A connector.

b. Set the RESPONSE selector to AUX VIDEO IN, the DISPLAY selector to 5 μs/DIV, and the VOLTS FULL SCALE selector to 1.0.

c. Connect the leveled sine-wave generator output, through the 50-to-75 Ω minimum loss attenuator, to the AUX VIDEO IN connector.

d. Set the leveled sine-wave generator frequency control to 50 kHz and output amplitude for 140 IRE units or 1 volt.

e. Set the leveled sine-wave generator frequency control to 18 MHz and adjust C1567 (Aux In Response), Fig. 8-4, for 126 IRE units or 0.9 volt of display height.

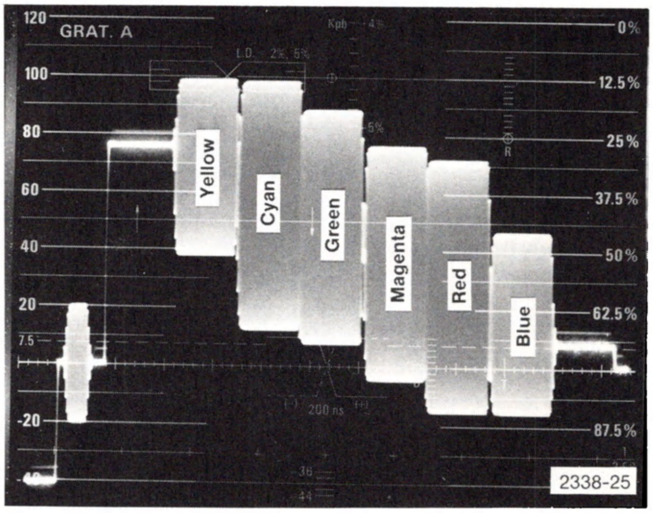

Fig. 8-5. Color Bar Signal identifying color bars.

f. Set the leveled sine-wave generator frequency control to 8 MHz and adjust R1626 (Off Screen Recovery) for 140 IRE units or 1 volt.

g. Repeat steps e and f until display is 126 IRE units or 0.9 volt (±5%) at 18 MHz, and 140 IRE units or 1 volt (±1%) at 8 MHz.

h. Remove the leveled sine-wave generator and video signal source connections to the 1480.

17.1. Baseline Recovery

a. Connect the SIN^2 X pulse-to-bar test signal from the video signal source to the AUX VIDEO IN connector, and Comp Sync to the EXT. SYNC (A ONLY) connector.

b. Set the VOLTS FULL SCALE selector to 0.2, the DISPLAY selector to 5 μs/DIV, and the MAGNIFIER to X5.

c. Locate the 20T modulated pulse, using the HORIZONTAL and VERTICAL POSITION controls on the 1480.

d. Alternately position the blanking level between −40 and +100 IRE units or 0 and 1 volt. Check for a change in separation between blanking and subcarrier of less than 5 IRE or 7 mV over this range.

NOTE

If Baseline Recovery is within this limit, procede to step 18. Otherwise, continue to part e of this step.

e. Position the blanking level to −40 IRE units or 0 volts, and adjust R1626 (Off Screen Recovery) to reduce the change in separation between −40 and 100 IRE units or 0 to 1 volt.

f. If it was necessary to adjust R1626, then repeat step 17. Adjust AUX VIDEO IN Response Change.

g. Disconnect the SIN^2 X pulse-to-bar test signal and Comp Sync from the 1480.

18. Adjust DC RESTORER Burst Trap

a. Set the DISPLAY switch to 2 FIELD, RESPONSE switch to FLAT, and VOLTS FULL SCALE selector to 0.2.

b. Press the FAST and BACK PORCH DC RESTORER pushbuttons.

c. Set the MAGNIFIER switch to X5 and rotate the POSITION controls to center the field interval on the crt.

d. Set P1993, on the Vertical board (Fig. 8-4), to the Fast Slew Rate position.

e. Adjust L1697 for 7 mV or less keyboarding (blanking level shift caused by presence of burst). In dual standard models, the adjustment of L1697 must be compromised for minimum keyboarding in both standards.

19. Adjust A Frequency Response

a. Connect the leveled sine-wave generator output, through the 50-to-75 Ω minimum loss attenuator, to the A VIDEO INPUT connector. Connect the peak-to-peak detector head to the A VIDEO INPUT loop thru.

b. Set the VOLTS FULL SCALE selector to 1.0, the INPUT selector to A DC COUPLED, and the RESPONSE selector to FLAT.

c. Connect the peak-to-peak detector head to the plus input of the peak-to-peak detector. Connect the peak-to-peak detector output to the DVM, using a BNC to dual banana plug adapter. Enable the peak-to-peak detector plus input and disable the minus input.

d. Set the leveled sine-wave generator frequency control to 50 kHz, and adjust its output for 140 IRE units or 1 volt of display height.

NOTE

The accuracy of calibration depends on how closely the signal level can be readjusted to the reference level. Therefore pay close attention to the display when setting the reference, and subsequent, levels.

e. Set the DVM to a range which will display 3 place accuracy. Adjust the peak-to-peak detector level on the plus input to as close to zero volts as possible. Note this voltage level.

f. Adjust the leveled sine-wave generator frequency controls to 3.58 MHz for the 1480 & 1482 (4.0 MHz for the 1485, and 4.43 MHz for the 1481).

g. Adjust the leveled sine-wave generator output amplitude control to obtain the same reading on the DVM as noted in part e.

NOTE

Readjusting the leveled sine-wave output to match the voltage level obtained at the reference eliminates any error in the leveled sine-wave generator. For example, if the reading at 50 kHz was 0.020 volts, and the reading at 3.58 MHz was 0.015 volts, then the error in the leveled sine-wave generator is 0.5%.

h. Adjust C1056 (A Input Comp) for 140 IRE units or 1 volt display height (same signal level as at reference) ±1% (typically within 0.5%). See Fig. 8-6.

i. Set the leveled sine-wave frequency controls to 7.0 MHz and adjust its output amplitude so that the DVM reading matches that obtained in part e.

j. Adjust C1244 (H.F. CMR) for 140 IRE units or 1 volt of display (+2, −3%).

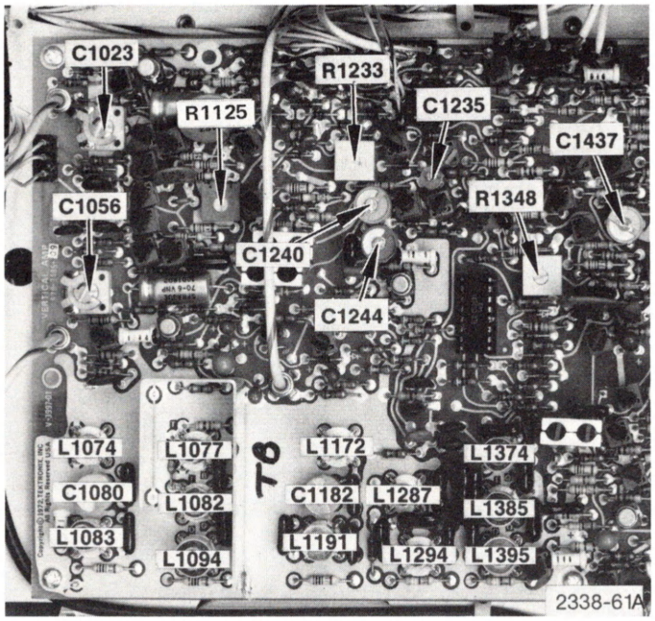

Fig. 8-6. Rear half of the Vertical Amplifier circuit board, showing adjustment numbers from 1000 to 1499. For adjustment numbers 1500 and above see Fig. 8-4.

k. Repeat parts f through j until response is within limits shown in Table 8-2 of this insert.

Table 8-2
RESPONSE TOLERANCE

Flat Response	IRE Units or Volts
50 kHz; 5 MHz ±1%	SEE NOTE
7 MHz +2%, −3%	
10 MHz +2%, −6%	

NOTE

The percentage of deviation from flatness should be measured and calculated in the following manner:

1. *Set the reference level as in parts d and e.*
2. *Set the leveled sine-wave generator to the frequency of interest and adjust its output amplitude to obtain a display on the 1480 of the same level as the reference signal. Note the reading on the DVM.*
3. *Subtract the DVM reading obtained in step 2 from the DVM reading taken at the reference to obtain the absolute error.*

Example I:

reference reading *+0.020*
4.0 MHz reading (after adj.) *+0.021*
0.001 = 0.1%

Example II:

reference reading *+0.020*
4.0 MHz reading (after adj.) *−0.021*
0.041 = 4.1%

l. Disconnect the leveled sine-wave generator output from the A VIDEO INPUT connector, and the peak-to-peak detector head from the A VIDEO INPUT loop thru.

19.1. Adjust B Frequency Response

a. Connect the leveled sine-wave generator output, through the 50-to-75 Ω minimum loss attenuator, to the B VIDEO INPUT connector. Connect the peak-to-peak detector head to the B VIDEO INPUT loop thru.

b. Set the VOLTS FULL SCALE selector to 1.0, the INPUT selector to B DC COUPLED, and the RESPONSE selector to FLAT.

c. Adjust the peak-to-peak detector level on the plus input to as close to zero volts as possible. Note this voltage level.

d. Adjust the leveled sine-wave generator frequency controls to 3.58 MHz for the 1480 & 1482 (4.0 MHz for the 1485, and 4.43 MHz for the 1481).

e. Adjust the leveled sine-wave generator output amplitude control to obtain the same reading on the DVM as noted in part c.

f. Adjust C1023 (B Input Comp) for 140 IRE units or 1 volt display height (same signal level as at reference) ±1% (typically within 0.5%).

g. Disconnect the leveled sine-wave generator and peak-to-peak detector head from the 1480.

20. Adjust Common-Mode Rejection

a. Connect the VAC through a dual input coupler to both the A and B INPUTS of the 1480, with no termination.

b. Set the VOLTS FULL SCALE selector to 0.2, INPUT to A-B, RESPONSE to FLAT, DISPLAY to 2 FIELD, and the MAGNIFIER to X1.

c. Set the VAC to MANUAL and set its output levers to 999.9 mV.

d. Adjust R1233 (L.F. CMR) for minimum signal.

e. Disconnect the VAC and connect the video signal source through a 75 Ω feed-thru termination and a dual coupler to the A and B VIDEO INPUTS.

f. Set the 1480 DISPLAY selector to 5 μs/DIV.

g. Adjust C1240 (M.F. CMR) for a null at mid-frequencies (2nd, 3rd, & 4th packets). The third packet should be less than 5 IRE.

h. Adjust C1235 (H.F. CMR) for minimum response at the highest multiburst frequencies (5th & 6th packets). The sixth packet should be less than 10 IRE.

i. Disconnect the video signal source and dual input coupler.

20.1. Adjust Luminance/Chrominance Gain

a. Connect the leveled sine-wave generator output, through the 50-to-75 Ω minimum loss attenuator, to the A VIDEO INPUT connector. Connect the peak-to-peak detector head to the A VIDEO INPUT loop thru.

b. Set the VOLTS FULL SCALE selector to 1.0, the INPUT selector to A DC COUPLED, and the RESPONSE selector to FLAT.

c. Connect peak-to-peak detector and DVM as described in step 19, part c.

d. Adjust the leveled sine-wave generator frequency controls to 50 kHz, and the output amplitude control for 140 IRE units or 1 volt display.

e. Adjust the peak-to-peak detector level on the plus input to as close to zero volts as possible. Note this voltage level.

f. Adjust the leveled sine-wave generator frquency controls to 3.58 MHz for the 1480 & 1482 (4.0 MHz for the 1485, or 4.43 MHz for the 1481).

g. Check that the response is within 1% (typically within 0.5%), using the method described in the note following step 19, part k.

h. Adjust C1056 (A Input Comp.) to bring the response within 1%, if necessary.

i. Move the leveled sine-wave generator and peak-to-peak detector head from the A VIDEO INPUT to the B VIDEO INPUT.

j. Set the INPUT selector to B DC COUPLED.

k. Set the leveled sine-wave generator frequency controls to 50 kHz and the output amplitude to 140 IRE units or 1 volt.

l. Adjust the peak-to-peak detector level on the plus input to as close to zero volts as possible. Note this voltage level.

m. Adjust the leveled sine-wave generator frequency controls to 3.58 MHz for the 1480 & 1482 (4.0 MHz for the 1485, or 4.43 MHz for the 1481).

n. Check that the response is within 1% (typically within 0.5%), using the method described in the note following step 19, part k.

o. Adjust C1023 (B Input Comp.) to bring the response within 1%, if necessary.

p. If either C1023 or C1056 were adjusted, repeat step 20. Adjust Common-Mode Rejection, and then step 20.1. Adjust Luminance/Chrominance gain.

q. Move the leveled sine-wave generator and peak-to-peak detector head from the B VIDEO INPUT to the A VIDEO INPUT.

r. Set the VOLTS FULL SCALE selector to 0.5, the INPUT selector to A DC COUPLED, and the RESPONSE selector to FLAT.

s. Adjust the leveled sine-wave generator frequency controls to 50 kHz, and the output amplitude control for 140 IRE units or 1 volt display.

t. Adjust the peak-to-peak detector level on the plus input to as close to zero volts as possible. Note this voltage level.

u. Adjust the leveled sine-wave generator frequency controls to 3.58 MHz for the 1480 & 1482 (4.0 MHz for the 1485, or 4.43 MHz for the 1481).

v. Adjust the leveled sine-wave generator output amplitude control to obtain the same reading on the DVM as noted in part e.

w. Adjust C1862 (0.5 VFS RESPONSE) for 140 IRE units or 1 volt ±2.0% (typically within ±1.0%). See Fig. 8-4.

x. Sweep through the frequencies from 50 kHz to 5 MHz, and verify that the response is within 2.0%. See note following part aa.

y. Set the VOLTS FULL SCALE selector to 0.2, and repeat parts s through v.

z. Adjust C1854 (0.2 VFS RESPONSE) for 140 IRE units or 1 volt, ±2.0% (typically within ±1.0%).

aa. Sweep through the frequencies from 5 kHz to 5 MHz, and verify that the response is within 2.0%. See note.

NOTE

Make the response check using the method described in the note following step 19, part k, with the following changes:

1. *With the VOLTS FULL SCALE selector set to 0.5, the % deviation will be twice the calculated value.*
2. *With the VOLTS FULL SCALE selector set to 0.2, the % deviation will be five times the calculated value.*

21. Adjust AUX VIDEO OUT Response

a. Leave the peak-to-peak detector attached to the VIDEO INPUT A loop thru, and attach the second peak-to-peak detector head to the AUX VIDEO OUT connector of the 1480.

b. Set the INPUT selector to A DC COUPLED and the VOLTS FULL SCALE selector to 1.0.

c. Adjust the leveled sine-wave generator frequency controls to 50 kHz, and the amplitude control for 140 IRE units or 1 volt.

d. Make sure that both the + and − inputs on the peak-to-peak detector are enabled, and adjust the + and − level controls so that the green light is on. Do not readjust the level controls after this step.

e. Note the voltage reading on the DVM.

f. Set the leveled sine-wave generator frequency controls to 5 MHz and adjust C1437 (Video Out HF Resp) on the 1480 until the reading on the DVM is within 30 mV (±3%) of the reading obtained in part e.

g. Set the leveled sine-wave generator frequency controls to 2 MHz and adjust R1525 (Video Out MF Resp) on the 1480 until the reading on the DVM is within 30 mV (±3%) of the reading obtained in part e.

h. Repeat parts f and g until response at 2 MHz and at 5 MHz is within ±30 mV (±3%) at each point.

22. Adjust IRE Filter (where used)

a. Set the RESPONSE switch to IRE, and the INPUT switch to A, AC CPL'D.

b. Set the video Signal Source for a five-step staircase, modulated with 140 mV of subcarrier.

c. Adjust L1287 (IRE Filter), Fig. 8-6, for no preshoot, overshoot, or ringing on luminance portions of the signal, and less than 14 mV of chrominance of the staircase.

23. Adjust LOW PASS Filter

a. Press the CAL and DC RESTORER SYNC TIP pushbuttons, and set the RESPONSE switch to LOW PASS.

b. Adjust L1374, L1385, L1395 (Low Pass Filter) for 0.5% or less overshoot or ringing on the corner of the leading edge of the calibrator square-wave. For adjustment location, see Fig. 8-6.

24. Adjust DIFF'D STEP Filter

a. Set the RESPONSE switch to DIFF'D STEP and press the OPER pushbutton.

b. Set the video signal source for a five-step staircase, modulated with 140 mV of subcarrier. The amplitude of the differentiated step-risers should be approximately 5X normal.

c. Adjust L1082 and L1094 (DIFF'D Step Filter) for maximum amplitude with minimum aberration. See Fig. 8-6 for adjustment locations.

d. Disconnect the cable from the video signal source Composite Video output connector and connect it to the Subcarrier output connector.

e. Adjust L1077 (DIFF'D Step Filter) for 20 mV or less displayed subcarrier.

f. Remove the cable from the video signal source Subcarrier output connector and connect it to the Composite Video output connector. Set the RESPONSE switch to FLAT.

25. Adjust 3.58 Bandpass Filter (where used)

a. Set the video signal source for a standard color bar test signal.

b. Set the VOLTS FULL SCALE selector and the VOLTS FULL SCALE VAR so the amplitude of the red bar is 1 volt or 140 IRE units.

c. Set the RESPONSE switch to 3.58 BANDPASS.

d. Adjust L1074, L1083, and C1080 (3.58 Filter) for a red bar amplitude the same as that set in part b of this step, so that the tops of the bars are flat, and the rise-and fall-times of the color burst are nearly identical. See Fig. 8-6 for adjustment location.

e. Replace the composite video input signal with the leveled sine-wave generator signal.

f. Set the leveled sine-wave generator frequency to 3.58 MHz and amplitude for a 140 IRE unit (or 1 volt) display height.

g. Check that the display amplitude is 3 dB from the reference (part f.) at 3.1 to 3.4 MHz and 3.8 to 4.0 MHz. (−3 dB=70% or 98 IRE). If the limit is not met, repeat all of this step.

26. Adjust 4.43 Bandpass Filter (where used)

a. Connect the video signal source to the VIDEO INPUT A connector and terminate the loop-thru connector in 75 Ω.

b. Set the video signal source for a standard color bar test signal.

c. Set the VOLTS FULL SCALE selector and VOLTS FULL SCALE VAR so the red bar amplitude is 1 volt in amplitude.

d. Set the RESPONSE switch to 4.43 BANDPASS.

e. Adjust L1172, L1191, and C1182 (4.43 Filter) for a red bar amplitude that is the same as that set in part c, so the tops of the bars are flat, and the rise-and fall-times of the color burst packet are nearly identical. See Fig. 8-6 for location.

f. Disconnect the video signal source and connect the leveled sine-wave generator output signal to the VIDEO INPUT, A connector.

g. Set the leveled sine-wave generator frequency for 4.43 MHz and amplitude for a 1 volt display.

h. Check that the display ampitude is within 3 dB of the reference amplitude at 3.9 to 4.1 MHz and 4.7 to 4.9 MHz. (−3 dB=70% or 700 mV). If the limit is not met, repeat all of this step.

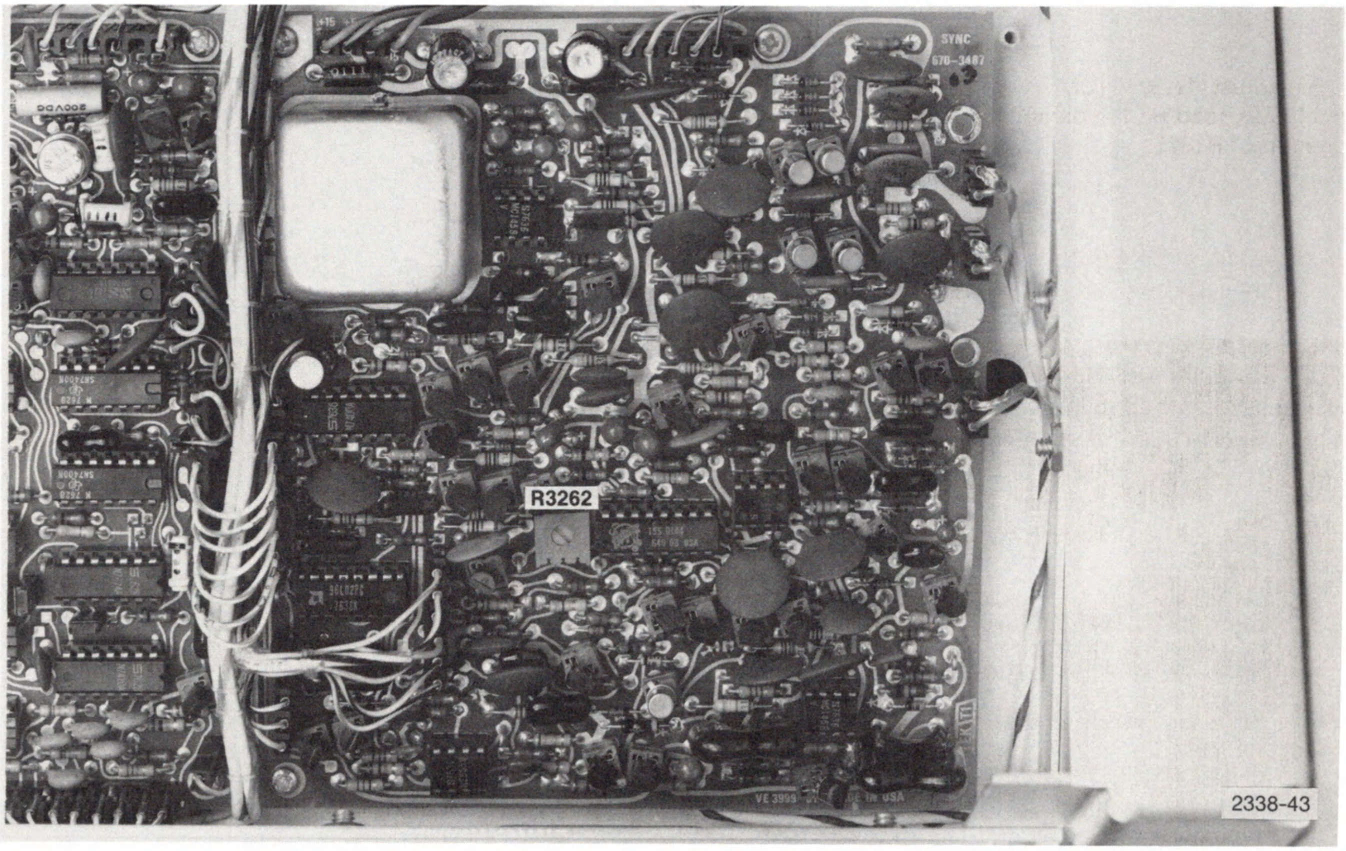

Fig. 8-7. Sync Board adjustment locations.

27. Adjust Calibrator Accuracy

a. Press the CAL and DC RESTORER SYNC TIP pushbuttons.

b. Connect AUX VIDEO OUT through a 75 Ω feed-through termination to the test oscilloscope differential comparator + Input.

c. Set the test oscilloscope Time/Div to 5 μs, Volts/Div to 50 mV, and for comparison voltage operation.

d. Connect the test oscilloscope differential comparator Vc Out to the digital voltmeter Hi Input.

e. Connect the digital voltmeter Lo Input to the test oscilloscope ground.

f. Set the test oscilloscope differential comparator Vc to 0000. Vertically position the bottom of the square-wave to graticule center. Note the digital voltmeter reading.

g. Rotate the differential comparator Fine Comparison Voltage control to set the top of the square-wave to graticule center.

h. Adjust R1827 (Cal Ampl) for 1 V square-wave amplitude, read on the digital voltmeter. See Fig. 8-4 for location of R1827.

28. Adjust GAIN

a. Press the DC RESTORER SYNC TIP pushbutton.

b. Adjust the GAIN control for 1-volt display height.

29. Adjust Burst Flag

a. Connect the video signal source Composite Video output signal to the VIDEO INPUT A connector and terminate the loop-thru connector in 75 Ω. Apply a color bar signal.

b. Set the 1480-Series controls as follows:

INPUT	A DC CPL'D
VOLTS FULL SCALE	0.5
VFS VAR	CAL (detent)
RESPONSE	FLAT
DC RESTORER	OFF—BACK PORCH
MAGNIFIER	X5
DISPLAY	10 μs/DIV
LINE SELECTOR	9
FIELD	Odd (Grey buttons depressed)
FIELD—LINE SELECT	OFF
SYNC	EXT—DIRECT

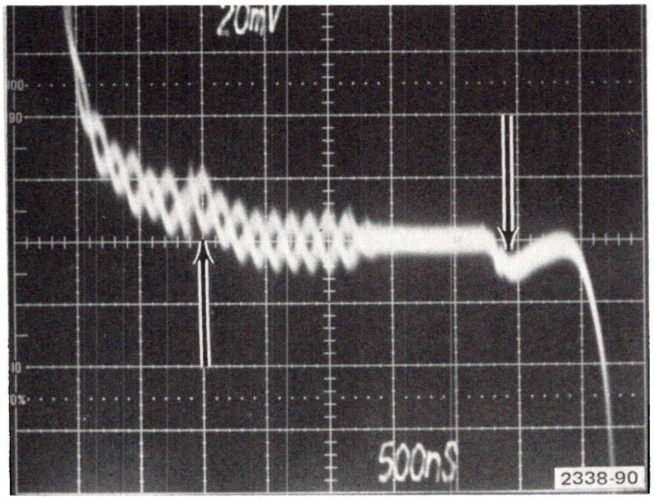

Fig. 8-8A. Display with R3262 misadjusted.

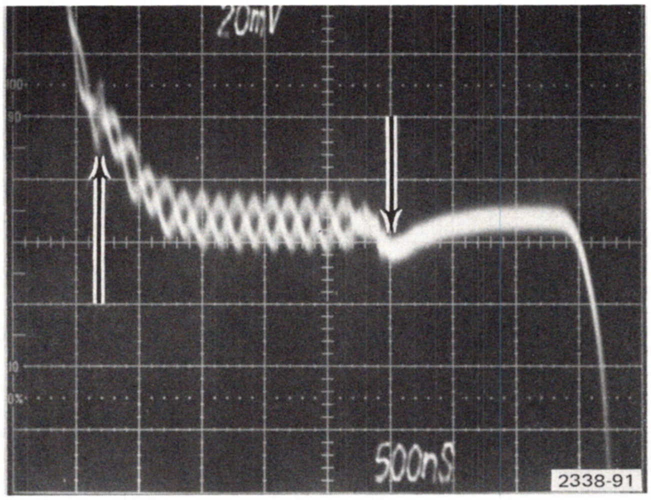

Fig. 8-8B. Display with R3262 properly adjusted.

c. Set the test oscilloscope deflection factor to 20 mV/Div, input coupling to AC, sweep rate to 500 ns/Div (.5 μs), triggering to Auto, trigger source to Ext, and trigger slope to (−).

d. Connect the test oscilloscope 10X probe tip to TP3170 on the Sync board.

e. Attach a 1X probe to the Trigger Input of the test oscilloscope and connect the probe tip to TP3050 on the Sync board. Adjust triggering of the test oscilloscope for a stable display.

f. Adjust R3262 (Burst Flag Adj) to position the notches (Fig. 8-8A) to occur on each side of the remnant of the color burst. Figure 8-8B shows the display with R3262 properly adjusted.

30. Adjust MAGNIFIER Registration

a. Set the DISPLAY selector to 2 FIELD and center the display, using the HORIZONTAL POSITION control.

b. Set MAGNIFIER μs/DIV to X50.

c. Rotate the HORIZONTAL POSITION control to set the last field-sync pulse at graticule center.

d. Set the MAGNIFIER to OFF and adjust R4240 (X5 Mag Regis) for registration (alignment of the signal to the same screen position as in unmagnified display) of the last field-sync pulse between MAGNIFIER X5 and MAGNIFIER OFF, and R4234 for registration of the last field-sync pulse between MAGNIFIER X50 and MAGNIFIER X5. See Fig. 8-9 for location adjustment.

31. Adjust Horizontal Gain and Timing

a. Disconnect the cable at the Composite Video output of the video signal source. Connect this cable to the time-mark generator output connector, and set the time-mark interval to 10 μs.

b. Connect the time-mark generator trigger signal to the A EXTERNAL SYNC input.

c. Press the SYNC EXT and DIRECT pushbuttons.

d. Set the DISPLAY selector to 10 μs/DIV.

e. Adjust R4532 (Horiz Gain) for 1 time-mark/div.

f. Set MAGNIFIER μs/DIV to 0.1 μs/DIV, and set the time-mark generator for 0.1 μs marks.

g. Adjust C4620 (Mag Timing) for 1 mark/div and linearity of ±3% over the area that corresponds to the center 10 divisions of unmagnified sweep.

h. Check magnified timing and linearity as in Table 8-3. If any of the limits are not met, repeat the step.

Table 8-3

TIME MARKERS	MAGNIFIER	DISPLAY	LIMIT
1 μs	0.2 μs	1 mark/5 div	±3%
1 μs	0.25 μs	1 mark/4 div	±3%
1 μs	0.5 μs	1 mark/2 div	±2%
1 μs	1.0 μs	1 mark/div	±1%

32. Adjust Horizontal Limiters

a. Connect the video signal source, Composite Video signal to the 1480-Series the VIDEO INPUT A connector and terminate the loop-thru connector in 75 Ω.

b. Set the RESPONSE switch to FLAT, VOLTS FULL SCALE selector to 1.0, and DC RESTORER selector to SLOW, BACK PORCH.

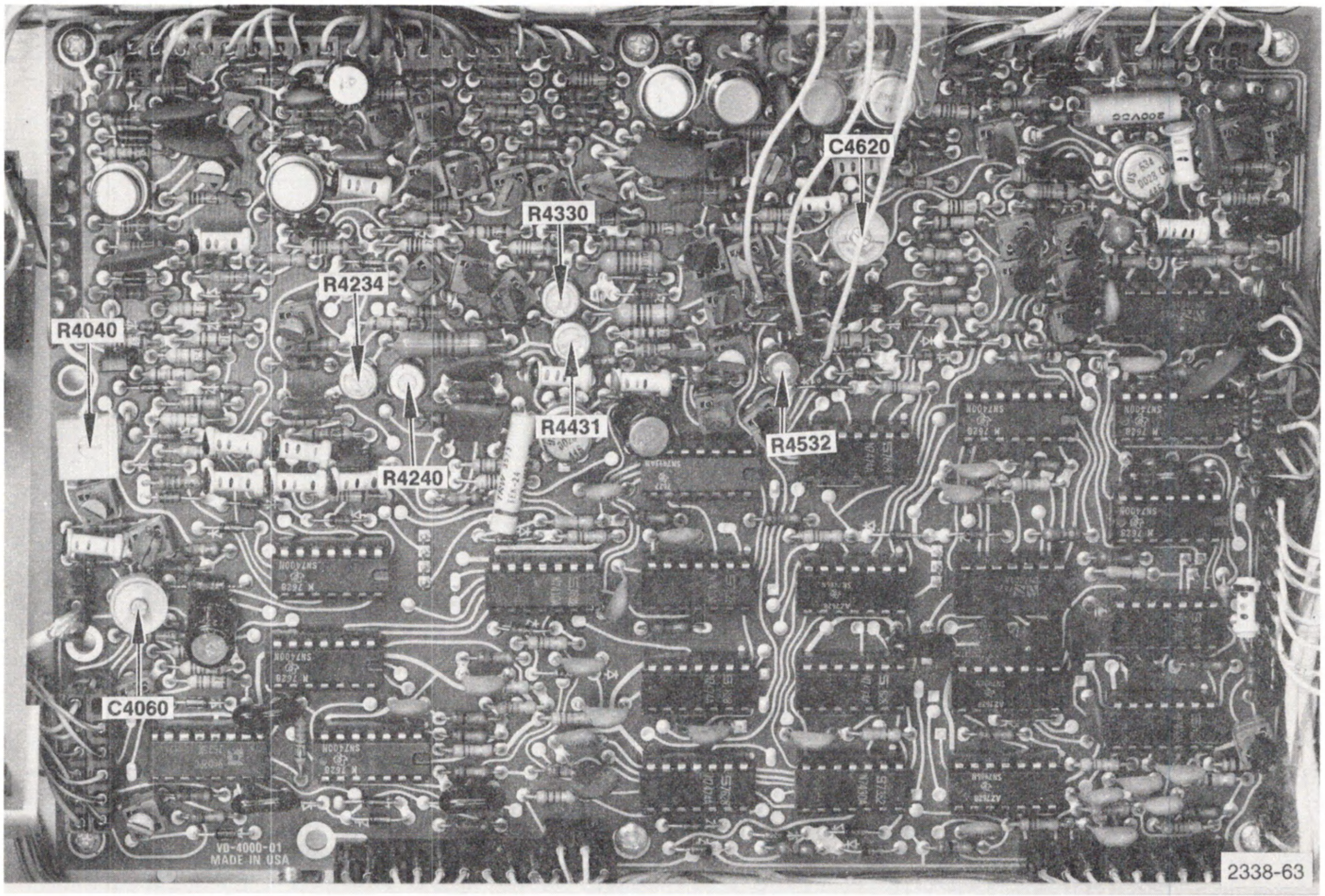

Fig. 8-9. Adjustment locations on Sweep Output board.

c. Set the video signal source for a color bar output.

d. Set the MAGNIFIER μs/DIV switch to X50 (.1 μs/DIV) and the DISPLAY switch to 10.

e. Connect the dc voltmeter through a 1 kΩ resistor to the collector of Q4400 (top end of R4501). The 1 kΩ resistor should be located at the voltmeter probe tip end to prevent the circuit from oscillating.

f. Rotate the HORIZONTAL POSITION control to the extreme left position (fully counterclockwise).

g. Adjust the left limiter (R4330) for a reading of +128 volts dc.

h. Rotate the HORIZONTAL POSITION control to the extreme right position (fully clockwise).

i. Connect the voltmeter probe tip (via 1 kΩ) to the collector of Q4600.

j. Adjust the right limiter (R4331) for a reading of +128 volts dc.

33. Adjust RGB/YRGB Operation

a. Connect the video signal source Composite Video output to the VIDEO INPUT A connector and terminate the loop-thru connector in 75 Ω.

b. Set the INPUT selector to A, AC CPL'D, DISPLAY selector to 10 μs/DIV, and MAGNIFIER μs/DIV to OFF. Press the SYNC INT and DIRECT pushbuttons.

c. Connect J9034 on the rear panel for RGB/YRGB operation (ground pin D, connect RGB/YRGB steps to pin C).

d. Connect a 3-step staircase from the Television Test Signal Generator to J9034 pin C. See Accessories in the rear of this manual for information on mating, male plug (P9034) for use with J9034.

e. Set the Television Test Signal Generator Amplitude control for three video lines in 12.7 div.

f. Adjust R4040 (RGB DC Bal) for a centered display without compression on either side.

g. Adjust C4060 (RGB Comp) for stability and optimum display detail.

h. Set the DISPLAY selector to 2 FIELD.

i. Check the display. There should be three fields in 12.7 divisions.

j. Remove plug-jumpers P4032 and P4240. Set the television test signal generator for a 4-step display and check the 2 FIELD and 10 μs/DIV DISPLAY switch positions for a 4-step display.

OPTION ADJUSTMENT

Option 1 (10X Probe Input)

Additional equipment required.

1—10X Passive Probe. For example, P6053B, Tektronix Part Number 010-6053-11.

34. Adjust Input Compensation

a. Connect the 10X probe to the test oscilloscope vertical input. Compensate the 10X probe, using the test oscilloscope Calibrator and signal.

b. Move the 10X probe to the 1480-Series 10X PROBE INPUT connector, and connect the probe tip to the CAL OUTPUT jack.

c. Press the CAL and DC RESTORER SYNC TIP pushbuttons.

d. Adjust C2228 (under the shield housing) for a square corner on the leading edge of the waveform. See Fig. 8-10 for location.

35. Adjust HF Compensation

a. Adjust the 1480-Series front-panel 10X PROBE GAIN for 1-volt display height.

b. Press the OPER pushbutton. Connect the video signal source Composite Video to the VIDEO INPUT A connector.

c. Terminate the loop-thru connector in 75 Ω.

d. Connect the 10X probe to the output of the loop-thru board.

e. Compare displays with the INPUT switch alternately in PROBE and A positions.

f. Adjust C2265 so that the chrominance packets are identical in the A and PROBE positions of the INPUT switch.

36. Adjust Probe Calibrator Amplitude

a. Connect the 10X probe to the test oscilloscope vertical input, and attach the probe tip to the 10X PROBE, CAL OUTPUT jack.

b. Measure the CAL OUTPUT amplitude, using the differential comparator comparison voltage feature of the test oscilloscope plug-in amplifier.

c. Adjust R2275 for exactly 1-volt amplitude.

There are no adjustments for OPTIONS 2, 3, 4, 5, or 7. Option 6 Adjustment Procedure is located in the Option 6 Supplemental Instruction Manual.

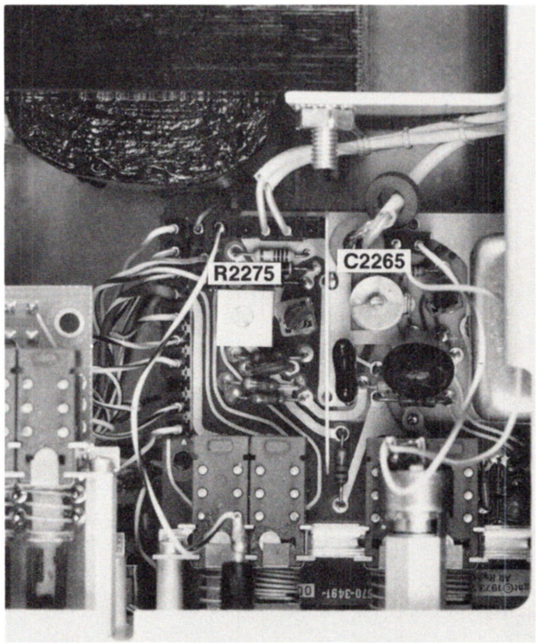

Fig. 8-10. Adjustment locations for calibration of Option 1 (10 X Probe).

THEORY OF OPERATION

This section, which serves primarily as a troubleshooting aid, is divided into two parts. The first, titled overview, is intended to provide a look at the 1480-Series Waveform Monitor by discussing the relationship of its individual circuits to one another. This is accomplished through the Block Diagram.

This part of the Theory of Operation section does not describe individual circuits. They are covered in the Circuit Description part of this section.

Dividing the Theory of Operation in this way should allow a technician to isolate any portion of the circuitry, for either further study or troubleshooting, and then get down to a closer examination of that circuitry.

OVERVIEW

The following discussion is of the instrument Block Diagram, which is located in the tabbed pages at the rear of this manual. This manual is constructed in such a manner that any of the tabbed pages may be extended while the text portion of the manual is being read.

The Block Diagram for this instrument is intended to be fully functional. It uses logic symbols, where applicable, even if the actual function is accomplished with discrete components. For example, amplifier functions are symbolized by the amplifier triangle symbol.

The numbers within the blocks correspond to the diagram on which that circuitry can be found.

Shaded blocks are circuits that are not found in all instruments of the 1480-Series. They may be used in only one scanning system or color standard as opposed to components that are used throughout the series, or they may be circuits used only in catalog options, such as Option 1 (10X Probe Input). In any case, they will be clearly defined in this discussion.

A waveform monitor is an oscilloscope, a very special-purpose oscilloscope. It requires three things to present a usable display: 1. a vertical-deflection signal, 2. a horizontal-deflection signal, and 3. a signal to unblank the crt.

Vertical Deflection

The input stages of the 1480-Series vertical provide a choice of displays: Video signals on the A or B inputs, the AUXiliary VIDEO INput, the Optional 10X PROBE INPUT, or a differential display (A−B). The normal signal path is through the +Amplifier to the non-inverting side of the Differential Amplifier. The −Amplifier is identical to the +Amplifier, making it possible, in A−B, to route the B input signal to the inverting input of the Differential Amplifier without fear of a differential error. A−B is commonly used for nulling applications.

The CALibrator signal, applied to the −Amplifier, is counted down from the line rate by two divide-by-two flip-flops. Voltage levels are selected from a precise, resistive divider. The amplitudes are selected by the DC RESTORER clamping levels. SYNC TIP will always provide a CALibrator amplitude of 1 volt. In BACK PORCH, the amplitude will either be 0.7 or 0.714 volt, dependent on the standard the instrument is operating in. A switch, whose setting is dictated by the selection of external graticules, coupled with the SCALE ILLUM selection switch, provides the correct BACK PORCH signal amplitude.

When both the OPER and CAL buttons are pushed, the A input signal is a superimposed on the calibrator amplitude. This provides a very accurate method of video level setting.

Following the Differential Amplifier are the various filters, custom designed for use in the video field. Selection of filters is through the RESPONSE switch. Also at this point, two 75-ohm video outputs are broken out. They are the AUX VIDEO OUT and PIX MONITOR OUT. They are identical except that the PIX MONITOR OUT has a line-strobe pulse added to it to brighten the line or lines that are being looked at.

The filtered output is then applied to the Clamped Amplifier, where dc restoration occurs. An additional input to this amplifier may be made from the AUX VIDEO IN, an internally-terminated (75 ohm) input that does not go through the filters.

Control over vertical magnification, positioning, and gain are accomplished in the Gain Control stage. When Option 4 or 5 is included in the instrument, an extra positioning-compensation and dc restorer disabling pulse are applied at this point.

After Gain Control, the push-pull signal is applied to the Deflection Input Amplifier and the Limiter. The signal is limited at this point to prevent amplitude excursions so large that overdrive recovery problems would result. The Deflection Amplifier, which follows, provides the final gain and the impedance matching required to drive the vertical deflection-plates of the crt.

Horizontal Deflection

Synchronization of the horizontal-deflection system is a major concern in any oscilloscope, including waveform monitors. This makes the sync circuits the ideal place to begin a discussion of the horizontal-deflection system of the 1480-Series Waveform Monitor.

Sync Switching provides a method of selecting the source of composite signal or the level transition (to trigger the Slow Sweep Option 7), which will be used to synchronize the horizontal-deflection system. Selection of either internal or external sync is by front-panel switches. An additional rear-panel slide switch makes it possible to select the external sync source with the B Video Input switching circuitry.

When the source of sync has been selected, the video signal is stripped away and composite sync is regenerated by the Sync Stripper.

Composite sync is supplied to the DC Restorer Timing stage to determine when the Clamped Amplifier is clamped.

Composite sync is also supplied to the AFC and Pulse Generator, where a 31 kHz lockout removes the equalizing pulses and serrations and applies the line-rate signal to a phase-locked loop (AFC). The phase-locked loop maintains the line-rate output even in the absence of line sync for about ten consecutive lines. The output of the phase-locked loop is applied to an AFC/DIRECT switching circuit, which either selects that output or the output of the 31 kHz lockout to drive H gating circuits throughout the horizontal deflection system.

Composite sync is integrated, peak-detected, and used to time the Field Sync Generator and 50-60 Hz Recognition circuit. In Tone Wheel Sync Option 7, AUX SYNC input is amplified and divided by two. This signal is used to reset the Field Sync Generator.

In dual-standard instruments, the 50-60 Hz Recognition circuit recognizes the change in field rate and alters operation of both the Line Counter and the Field-Sweep Generator to maintain sweep accuracy.

The Field Recognition circuit reacts to the coincidence of the V and H pulses. When the field (selected by front-panel pushbutton) is recognized, the Line Counter is enabled and counts to about line 23 of that field. Because the Line Counter starts only on the selected field, Field Sweep will always start with the selected field, even in 2 FIELD SWEEP displays.

The Field-Gate Generator, which enables the Field-Sweep Generator, can be enabled directly from the Line Counter or be held off until the frame pulse from the Frame Recognition circuit arrives. The frame pulse, generated only in PAL or PAL-M instruments, is generated by the Frame-Pulse Generator. The frame pulse is generated only when there is a subcarrier signal, burst gate and enable pulse fed back to the Frame-Pulse Generator. The enable pulse only occurs at lines 6 and 319 in the PAL system, or field 3 line 8 and field 4 line 270 in the PAL-M system.

A Field Gate output enables the Field-Sweep Generator, whose ramp is normally two fields long, but is shortened for ALL FIELDS displays. The field-sweep ramp is routed to the Horizontal Switching circuitry. The Field-Sweep Generator also generates a delayed gate that is supplied to the Line Selector Logic.

The Line-Sweep Generator is gated by H pulses from the AFC and Pulse Generator. The sweep ramp is supplied to the Horizontal Switching Logic stage. The delayed gate from the Line-Sweep Generator is used for the LOCATE function of WAVEFORM COMPARISON.

Line Selector Logic is used with the digital line selecting process as well as VARiable and 15 LINES. Its output not only delays the Line-Sweep Generator starting point, but also is responsible for the Line Strobe.

Both line and field sweep are supplied to Horizontal Switching Logic, and either can be selected by the front-panel DISPLAY switch. External Horizontal Input, Tone Wheel Sync Horizontal Switching (Options 4 and 5) and RGB Steps are also inputs to the Horizontal Switching Logic.

The signal from the Horizontal Switching Logic is applied to the Horizontal-Deflection Input Amplifier, where positioning offset current from the Horizontal Positioning circuit is added, and the signal is altered by magnification selected by the front-panel MAGNIFIER switch.

The Horizontal Limiter ensures that the signal, no matter how highly magnified, does not overdrive the Horizontal-Deflection Amplifier, or cause any non-linearity or other distortion. The Horizontal-Deflection Amplifier sets the output gain and matches the impedance to the crt horizontal-deflection plates.

The Slow-Sweep Generator (Option 7) is triggered by a large APL change sensed in the Sync Stripper circuitry. The Slow Sweep output signal is a ramp, whose duration may be longer than 12 seconds at its slowest, and an unblanking pulse. The sweep ramp is applied through the Line Selector Logic to the Field-Sweep Generator.

Unblanking

Unblanking signals from either the Line-Sweep Generator or the Field-Sweep Generator and the Line Selector Logic are supplied to the Unblanking Gate in the Z-Axis Logic circuit, where intensity control is added. The Z-Axis Amplifier boosts the amplitude of the unblanking signal to levels capable of unblanking the crt.

CIRCUIT DESCRIPTION

This portion of the theory of operation describes the individual circuits of the 1480-Series Waveform Monitor. It is written to take advantage of the blocking of the individual circuit diagrams. Each of the paragraph heads corresponds to a block title on the schematic diagram under discussion.

DIAGRAM 1
VERTICAL INPUT

Circuits on this diagram accept signals from the A and B VIDEO INPUTS on the rear panel, from the Internal Calibrator, or the optional front-panel X10 PROBE INPUT. The signals are routed according to front-panel switching to the Differential Amplifier via the + and −Amplifiers.

A Input

Signals connected to the rear-panel A VIDEO INPUT are applied to C1057 and the collector of Q1054 through the parallel RC network R1061-C1056. C1056 is the A INPUT compensation.

Q1054 is controlled by the position of the INPUT switch via Q1051 and Q1052. With the front-panel INPUT switch in an AC CPL'D position, +10 V is applied to the base of Q1052. Q1054 cannot conduct in this case, so the input signal is coupled through C1057 to the emitter of Q1062. With the front-panel INPUT switch in a DC CPL'D position, +10 V is applied to the base of Q1051, turning Q1051 on, saturating Q1054, and routing the input signal around C1057 to the emitter of Q1062.

The rear-panel input connectors can be isolated from the chassis so that cable shields connect to Q1062's base-network rather than ground. R1072-C1073 shunt high-frequency noise to ground, while hum arrives at the base of Q1062 through CR1071. The hum on the base of Q1062 is in phase with hum in the composite video signal at the emitter of Q1062, and is rejected differentially.

B Input

The B VIDEO INPUT is identical to the A VIDEO INPUT circuit. Q1036 and Q1025 form the ac-dc coupling switch, controlling the conduction of Q1026. Q1007 is the differential input for the floating ground.

Input Switching

A group of diode-transistor switches route the A, B, CALibrator, and X10 PROBE INPUT (Option 1) signals to the appropriate amplifier. Switching is accomplished by a system of ground closures on the front-panel INPUT, CAL and OPER switches. Signals are routed according to Table 9-1.

Table 9-1

INPUT Switch Setting	CAL-OPER Switch Setting	INPUT	Routed to
A	OPER	A	+Amplifier
B	OPER	B	+Amplifier
A-B	OPER	A	+Amplifier
A-B	OPER	B	−Amplifier
A or B or A-B	CAL	(calibrator)	−Amplifier
A	(both)	A	+Amplifier
A	(both)	(calibrator)	−Amplifier
B	(both)	A	+Amplifier
B	(both)	(calibrator)	−Amplifier
PROBE	OPER	PROBE	+Amplifier
PROBE	CAL	PROBE	+Amplifier
PROBE	(both)	PROBE	+Amplifier

Signal Switching with INPUT in A. With the front-panel INPUT switch in A, P1206-3 is grounded, forward-biasing CR1145, saturating Q1063, and reverse-biasing CR1058. Signal flow in this condition is from the collector of Q1062 through Q1063 to the summing junction of the +Amplifier, the base of Q1141. CR1116 is also forward-biased in the A position. This saturates Q1121, providing holding current for the −Amplifier so that the −input of the Differential Amplifier is balanced with the +input.

Q1253-CR1147-CR1107, the switch for B signal to the +Amplifier, is off for lack of ground at the anodes of CR1147 and CR1107.

Signal Switching with INPUT in B. With the front-panel INPUT switch in B, P1206-2 is grounded, forward-biasing CR1107 and CR1147, saturating Q1253, and reverse-biasing CR1108. Signal flow now is from the collector of Q1007 through Q1253 to the summing junction of the +Amplifier, the base of Q1141. CR1114 is also forward-biased at this time to saturate Q1121, providing −Amplifier holding current.

CR1145-Q1063, the A signal to the +Amplifier switch, is off for lack of ground at the anode of CR1145.

Signal Switching with INPUT in A−B. With the front-panel INPUT switch in A-B, CR1144 in the A Input and CR1112 in the B Input are forward-biased, saturating Q1063 at the input to the +Amplifier and Q1008 at the input to the −Amplifier. This forms two signal paths; one, for A signals, from the collector of Q1062 through Q1063 to the +Amplifier; the other, for B signals, from the collector of Q1007 through Q1008 to the −Amplifier.

The other switching diodes are off, blocking any other signal path to either amplifier.

Calibrator Input Switching. Q1303, U1223, and Q1322 form the Calibrator Input circuit, driving the −Amplifier with the internal calibrator squarewave. The internal calibrator signal may be used in two different modes; first, by itself as a gain calibration aid; second, with the A VIDEO INPUT signal superimposed on it, as a check of incoming signal amplitude.

In the first mode, switching is accomplished by grounding the anodes of CR1321 and CR1204. Grounding the anode of CR1321 saturates Q1227, routing the calibrator signal to the −Amplifier. Grounding the anode of CR1204 saturates Q1127, providing holding current for the +Amplifier, balancing the Differential Amplifier.

In the second mode, the anodes of CR1321 and CR1243 are grounded, routing the calibrator signal through Q1227 to the −Amplifier and the A VIDEO INPUT signal through Q1063 to the +Amplifier. Calibrator switching is accomplished by pressing both front-panel CAL and OPER pushbuttons, saturating Q1063 (by grounding CR1243 through the OPER switch). Q1253 is turned off by the CAL switch, removing the INPUT switch ground. In this mode, the A VIDEO INPUT signal will always be superimposed on the calibrator signal.

Calibrator Input

With the front-panel CAL switch pressed, the A and B inputs are switched off for lack of ground at the anodes of their switching diodes. CR1321 is forward-biased by the ground at its anode through the CAL switch. Q1227 is saturated to provide a signal path for the calibrator signal.

The amplitude of the calibrator signal is determined by the current through R1307, which is in turn determined by the voltage at pin 6 of voltage-follower U1223. The voltage at U1223 pin 6 is controlled by three switches; the first is the front-panel BACK PORCH/SYNC TIP switch, the second is S9955 (located just below the crt), and the third is the INT-EXT SCALE ILLUM control.

With the front-panel SYNC TIP button pushed, the calibrator amplitude provides 1 volt peak-to-peak equivalent display. With the front-panel BACK PORCH button pushed, the calibrator amplitude is determined by S9955. S9955 has two positions: The first is for PAL and PAL-M systems and provides a 700 mV peak-to-peak equivalent display. The second, for NTSC, provides a 714 mV peak-to-peak (100 IRE) display. The switch positions are set by the external graticule. A push-pull switch on the SCALE ILLUM control permits overriding the graticule switch when an internal graticule is used. The BACK PORCH and SYNC TIP switches and S9955 pick levels off a precision resistive divider (R1827-R1921-R1914-R1915-R1913 shown on diagram 15) to drive the +input of U1223.

The calibrator is gated by a squarewave of four lines duration from U4640B (on diagram 7) through CR1301 to the emitter of Q1303. When the calibrator-gating signal goes positive, CR1322 is reverse-biased, allowing the calibrator signal to drive the −Amplifier through CR1325 and Q1227. When the calibrator-gating signal goes negative, CR1325 reverse-biases and CR1322 forward-biases to shunt the calibrator signal away. Current through R1329 holds the −Amplifier in conduction during this period.

+Amplifier

Q1141, Q1142, and Q1241 form an operational amplifier. The output of the stage is the instantaneous input-current times the feed-back resistance R1251. The +Amplifier output drives the positive input of the Differential Amplifier.

A second output provides the signal for internal SYNC through Q1542 to the Sync Stripper (diagram 5).

−Amplifier

Q1137, Q1136, and Q1242 form another operational amplifier to drive the −input of the Differential Amplifier. Feed-back resistance is R1235 in series with R1233, a variable resistor used to match the gain of the −Amplifier to that of the +Amplifier.

R1125 (DC Bal) provides balanced input current to both amplifiers. C1235, C1240 and C1244 match the mid and high-frequency gain of the + and −Amplifiers to achieve good common-mode rejection in the Differential Amplifier.

+10 V Supply

Q1037 supplies the +10 volts required by the ac-dc coupling switches, activated by the INPUT switch.

X10 Probe Switching (Option 1)

Probe switching is identical to the other switch functions. Selecting X10 PROBE INPUT grounds the anode CR1234 (reverse-biasing it), reverse-biasing CR1158, and saturating Q1157, to couple the signal from Q1155 (a common-base amplifier) to the +Amplifier.

DIAGRAM 1 a
X10 PROBE OPTION
(Option 1)

This diagram has the optional circuitry for the X10 PROBE INPUT. It covers the probe input amplifier and the calibrator circuit.

X10 PROBE INPUT

Q2259 and Q2244 form a X10 amplifier to compensate for the 10X attenuation of the probe. C2238 is the dc blocking capacitor. R2247 (hf bypassed by C2246) is the overload protection for Q2259 (FET input stage). In X10 probe operation, R2266 and the X10 PROBE GAIN (R9920), in series, are the input resistance for the +Amplifier.

Probe Calibrator

Q2274 is an off-on switch controlling a voltage divider consisting of R2275, R2276, R2278, and R2279. Q2274 switches the output between 0 and 1 V at the same repetition rate as the internal calibrator.

DIAGRAM 2
FILTERS & AUX VIDEO OUTPUT

Circuits on this diagram amplify the input signal, filter it according to front-panel commands, and route it to the Gain Control circuitry. Circuits here also provide unfiltered rear-panel outputs (PIX MONITOR OUT and AUX VIDEO OUT).

Differential Amplifier

C1235, Q1340 and Q1236 form a Differential Amplifier, with Q1431 providing constant current. Current is controlled by the voltage set by Q1435. The base of Q1340 is the input from the +Amplifier. The base of Q1236 is the input from the −Amplifier.

Amplifier gain control is accomplished between the emitters, with R1348 (Gain Out) used to set AUX VIDEO OUT to unity gain. Thermistor R1335 compensates for gain changes caused by heat variations.

In the A or B positions of the INPUT switch, only the +input (the base of Q1340) is driven. The −input is held at a constant level by the output of the −Amplifier. The signal at the base of Q1340 is inverted from the signal at the input of the +Amplifier.

The output of Q1340 drives a seven-transistor array, U1347, in the Filter Switching circuit. The collector of Q1236 drives the input of an amplifier in the Video Out circuit.

If the front-panel INPUT switch is in A−B, the output of the Differential Amplifier is the instantaneous difference between the two input signals. If the input signals are identical, the crt display will be a straight line.

Filter Switching

U1347, a seven-transistor array, is the active device in the Filter Switching stage. All the transistor emitters simultaneously receive the signal from the positive side of the Differential Amplifier.

Each of the bases in U1347 is connected to −10 V (at the emitter of Q1435 in the Differential Amplifier bias network) through one end of a resistor divider. The other side of the divider is grounded by one of the front-panel RESPONSE switch positions. When the divider circuit is completed, that transistor is turned on, passing the signal present at its emitter to the filter.

U1347C is used as a filter-off switch, and is turned on when P1696-2 is grounded. This ensures that none of the filters pass any signal when the front-panel RESPONSE switch is in the AUX VIDEO IN position.

It should be noted at this point, that in the LOW PASS position, the operation of the Restorer Timing circuit (on diagram 7) is altered. The DC Restorer Timing pulse is delayed to compensate for the longer propagation delay of the LOW PASS FILTER. SYNC TIP restoration is totally inhibited.

In the DIFF'd STEPS position of the RESPONSE switch, Q1465 (on diagram 3) saturates to inhibit all dc restoration.

Either CR1351, CR1355, or CR1364 is forward-biased when one of the ac-coupled filters is in use. This controls the DC Coupled Filter Current Balance circuit (diagram 3).

Filters

There are seven filters used in 1480-Series Waveform Monitors, and up to six may be incorporated in a single instrument. Instruments operating on NTSC standard (except PAL-NTSC dual-standard) contain an IRE filter. Instruments operating on PAL standard use a LUMinance filter instead. Single-standard PAL-M instruments also employ the LUM filter.

Bandpass filters are provided according to the standards employed in the instrument. NTSC and PAL-M instruments have 3.58 MHz BANDPASS filters, while PAL instruments have a 4.43 MHz BANDPASS filter.

The single-standard models (1480, 1481, 1482) have only one BANDPASS filter. In these instruments, an extra FLAT Position on the RESPONSE switch has been provided.

The dual-standard model (1485) has both a 3.58 MHz and a 4.43 MHz BANDPASS filter and does not have an extra FLAT position.

DIFF'D STEPS. U1347F drives the DIFF'D STEPS filter. The staircase risers charge C1181 through L1082-R1075 during leading edge time. Then, during the flat portion of the step C1181 discharges through L1094. C1181 charges to the amplitude of each riser, then discharges back to the starting level. The top of each riser becomes the peak of a differentiated pulse.

C1171, L1077, and R1076 pass chrominance to ground.

4.43 BANDPASS. The bandpass of this filter is about 800 kHz, centered at 4.43 MHz. L1191 is adjusted for amplitude, while L1172 and C1182 are adjusted for envelope shape and zero insertion-loss, respectively.

3.58 BANDPASS. The bandpass of this filter is about 700 kHz, centered around 3.58 MHz. L1083 is adjusted for amplitude while L1074 and C1080 are adjusted for envelope shape and zero insertion loss, respectively.

FLAT. This position of the RESPONSE switch passes the signal, unfiltered, through U1347B to the Clamped Amplifier (diagram 3).

IRE. This Pi filter has a rolloff curve conforming to IRE Standard 23S-1 1958. At 3.6 MHz, the chrominance portion of a signal is attenuated about 20 dB. At 4.43 MHz, chrominance is attenuated 22 dB or more.

LUM. This filter is designed to pass lower frequencies and attenuate higher ones. Attenuation is less than 3 dB at 1 MHz and greater than 40 dB at 4.43 MHz.

LOW PASS. This filter is designed to pass only the luminance portion of the signal; everything above 500 kHz is attenuated 14 dB or greater.

Video Out

The collector of Q1236 (Differential Amplifier negative output) drives the emitter of Q1421, the input of an operational amplifier. The gain of the stage is the instantaneous input current times R1422, and R1517; high frequency compensation is accomplished by peaking network R1525-C1519.

The signal at the emitter of Q1529 is 2 volts peak-to-peak for a 1 volt peak-to-peak input.

The Video Out amplifier is compensated at high frequencies by R1432 and the Video Out H.F. Response adjustment (C1437), and at mid-frequencies by C1519 and the Video Out M.F. Response adjustment (R1525).

At the PIX MONITOR OUT output, Q1402 inserts the Line Strobe (from the Line Selector circuit on diagram 8), on the selected line or lines when in LINE SELECTOR modes.

DIAGRAM 3
DC RESTORATION AND GAIN CONTROL

Circuits on this diagram provide dc restoration, gain control, and vertical positioning.

Clamped Amplifier

Q1472, Q1470, Q1475, and Q1489 form an operational amplifier. The signal output of the amplifier is R1491 +R1587 times the instantaneous input current. C1593 and R1495 compensate the gain at high frequencies. C1567 Aux In Response is adjusted for flat-frequency response at mid and high frequencies.

DC Restorer

U1890 is an operational amplifier used in the "sample and hold" mode. The Clamped Amplifier output (with chrominance information rejected by L1697 and C1688) is applied to the +input, while the −input of U1890 is referenced to ground. During sync tip or back porch time, depending on front-panel commands, the amplifier bias input (pin 5) is enabled by a pulse from the collector of Q1891. The level at the +input is transferred through to memory capacitor, C1888.

In the FAST DC RESTORER mode, the level on the memory capacitor is applied through source-follower Q1785 to the Clamped Amplifier input.

In the SLOW DC RESTORER mode, Q1793 is turned on by +15 V at P1898-3, inserting C1892 in parallel with memory capacitor C1888 to slow down the restoration of the amplifier output level following an offset.

When the DC RESTORER OFF button is pushed, ground is removed from P1696-9, saturating Q1483 and referencing the amplifier input to ground through R1477.

When the front-panel RESPONSE switch is in the DIFF'D STEPS position, R1557 is grounded through P1696-5, disabling the DC Restorer by saturating Q1465. When the front-panel RESPONSE switch is in other positions, R1557 is returned to −15 volts to ensure that Q1465 is cut off.

Aux Video In Switching

When the RESPONSE switch is in the AUX VIDEO IN position, the base of Q1691 is grounded through R1695 and Q1691 is turned on. Q1496 turns off and Q1396 turns on, passing the AUX VIDEO IN signal through Q1396 to the input of the Clamped Amplifier.

With the front-panel RESPONSE switch in any other position, the ground is removed from P1696-2, turning Q1691 and Q1396 off; Q1496 is turned on, grounding the AUX VIDEO IN signal.

The values of R1493 and R1591 make AUX VIDEO IN sensitivity 1.5 dB greater than the A and B VIDEO INPUTS.

DC Coupled Filter Current Balance

When the front-panel RESPONSE switch is in one of the dc-coupled filter positions (LOW PASS, IRE, or FLAT) Q1452 is turned on by the lack of a positive level from CR1355, CR1351, or CR1364 in the Filter Switching circuit. Q1452's conduction turns on Q1455, which becomes a current-sink for about 5 mA of current that would otherwise offset the vertical-deflection system and deflect the display off-screen.

Gain Control

The Clamped Amplifier output is applied through R1585, front-panel GAIN, and VOLTS FULL SCALE VAR controls to the base of Q1670B. Q1670A and B form a paraphase amplifier with selectable gain-determining components in the emitter circuit. The base voltage of Q1670A is set by the VERTICAL POSITION control.

The selectable current-sources in the emitter circuit provide for VOLTS FULL SCALE switching and DIFF'D STEPS expansion. The current source for 1.0 VOLTS FULL SCALE is Q1875. For 0.5 VOLTS FULL SCALE, Q1861 is the current source, R1864 and C1862 (0.5 V.F.S. Resp) compensate the amplifier at high frequencies. For 0.2 VOLTS FULL SCALE, Q1847 is the current source, R1851 and C1854, (0.2 V.F.S. Resp) compensate the amplifier at high frequencies.

When the front-panel RESPONSE switch is in the DIFF'D STEPS position, Q1775 is turned on. The common-emitter connection between Q1775 and the VOLTS FULL SCALE current-sources holds Q1875, Q1861, and Q1847 off. Q1775's emitter is at the same voltage as the base of whichever of the other three transistors would have been selected by the VOLTS FULL SCALE switch. DIFF'D STEPS RESPONSE provides about five times vertical expansion of the input signal.

The output of the amplifier drives through a series-parallel peaking network, compensated by C1666 (Vert H.F. Response) to the input of the Vertical Deflection Amplifier. R1666 (Vert Centering) balances the output levels.

DIAGRAM 4
VERTICAL DEFLECTION

Circuits on this diagram amplify the signal to the levels required to deflect the crt, trace vertically, prevent excessive overdrive, and match crt impedance.

Deflection Input Amplifier

Q1754 receives the signal from the Gain Control +Output (Q1670A) and Q1654's signal is from Q1670B. The Deflection Input Amplifier is a differential amplifier with collector-to-base feedback for stability.

The Deflection Input Amplifier drives the Limiter circuit.

Limiter

The Limiter is a push-pull amplifier with a constant-current source (Q1747) in the emitter circuit. The collector loads are diode-resistor networks. Voltage excursion on the collectors is limited to about two volts peak-to-peak.

The upper-voltage limit to either side of the amplifier occurs when the drive on the opposite side of the amplifier demands all the available emitter-current. At that time, the diode bias-resistor (for example, R1739 on the + side) satisfies the diode's demand for current and the collector is at about +12.5 volts.

The lower-voltage limit occurs when the drive signal changes and the transistor formerly demanding no emitter-current now demands all of it. At that time, the collector level is about 12.5 volts minus the drop across the collector load (for example, R1735 on the +side).

The Limiter drives the input of the differential Deflection Amplifier.

Deflection Amplifier

The bases of Q1621 and Q1732 are driven simultaneously with opposite polarity signals. The gain of each side is 24.

The outputs from common-base amplifiers Q1617 and Q1723 are applied to the crt deflection plates through parallel LR networks LR1703 and LR1603 that compensate for deflection-plate capacitance.

L1707 and L1605 (Vertical Response) compensate the gain of the stage at high frequencies.

DIAGRAM 5
INT/EXT SYNC SWITCHING

Circuits on this diagram select sync signals from the EXTERNAL SYNC inputs, or from the vertical system.

Also on this diagram are the Sync Stripper, which provides chroma-free sync signals used throughout the sweep and unblanking circuits, and the frame Pulse Generator, used in the PAL and PAL-M.

A Sync Input

The signal from the EXTERNAL SYNC A loop-thru connector is applied through series RC network R3411-C3411 to the emitter of Q3311. The high-impedance bridging inputs can be isolated from the chassis, so that the cable shield connects to Q3311's base. If this is done, any hum present on the shield (base of Q3311) is in phase with hum in the signal at the emitter of Q3311, and is rejected differentially. The EXTERNAL SYNC A signal passes through Q3311 to the Sync Switching circuit. The emitter of Q3311 is connected to the collector of Q3310, which supplies 1 mA of constant current.

B Sync Input

The B Sync Input circuit is identical to the A Sync Input stage. Q3320 supplies the constant current, and Q3321 is the signal path to the Sync Switching circuit.

Internal Sync Input

The emitter of Q3441 receives the signal picked off at the +Amplifier (on diagram 1). The coaxial-cable shield is connected to Q3441's base for differential rejection of hum. Internal Sync is coupled through Q3441 to the Sync Switching circuit.

On all models except the NTSC single-standard, the Video signal from the internal sync pick-off is also applied to Q3440, the input to the Frame-Pulse Generator.

Sync Switching

The signal ultimately applied to the Sync Stripper circuit can be derived in several different ways.

Internally, the input video from A or B channel (whichever is selected by the front-panel INPUT switch,) is picked off at the +Amplifier and routed through Q3441 to the Sync Amplifier. CR3333 is forward-biased when CR3430 is reverse-biased. CR3430 is reverse-biased when CR3330 is forward-biased by a ground closure at the front-panel INT SYNC selector.

When Input A and EXT SYNC are selected, P3200 pins 3 and 5 are grounded, forward-biasing CR3302, CR3200, and CR3319. This reverse-biases CR3311, CR3300, and CR3320. This allows signal current from Q3311 to pass through now forward-biased CR3331 to Q3330.

The B Sync Input cannot supply any signals to the Sync Amplifier, because CR3312 is reverse-biased for lack of ground at its cathode. Collector current in Q3321 is shunted away through CR3321.

When Input B and EXT SYNC ALWAYS (A) are used and the EXT SYNC pushbutton is pressed, CR3200 at the A Sync Input and CR3319 at the B Sync Input are forward-biased, reverse-biasing CR3300 and CR3320.

P3200-1 is grounded. This forward-biases CR3310 to reverse-bias CR3311. Collector current in Q3311, which was shunted away by the diode-switch is now routed to the Sync Amplifier.

The B Sync Input cannot supply any signals to the sync because CR3312 is reverse-biased.

The Int Sync Input cannot supply signals to Q3330 in this case because of the similar diode-switch at the collector of Q3441. CR3330 is reverse-biased and Q3441's collector current is shunted away through CR3430.

When INPUT B, EXT SYNC SWITCHED WITH INPUT SWITCH (A) or (B), and EXT SYNC are selected, the ground on the cathode of CR3310 is removed, causing CR3311 to return to the forward-biased state, which causes CR3331 to reverse-bias and remove the A sync from the Sync Amplifier. At the same time, CR3312 forward-biases, reverse-biasing CR3321. With both CR3321 and CR3320 reverse-biased, CR3332 forward-biases and the sync information from B is routed to the Sync Amplifier. The internal sync information is still shunted off.

reverse-biasing CR3321. With both CR3321 and CR3320 reverse-biased, CR3332 forward-biases and the sync information from B is routed to the Sync Amplifier. The internal sync information is still shunted off.

When the INPUT switch is in A−B, the A input sync information is routed to the Sync Amplifier in the same manner as when the switch is in A.

Sync Amplifier

The Sync Amplifier is made up of Q3330, a common-base amplifier, and Q3241, an emitter-follower. Q3241 drives the Sync Stripper through a series network consisting of R3344 and C3252.

Sync Separator

The Sync Separator itself is U3267. It is designed to work with sound-on-syncs. P3275 (which is not normally supplied) fills in the missing sync when in place. If P3275 is used, sync duration is slightly longer.

Q3276, an emitter-follower, is the sync output. It prevents loading of the Sync Separator (U3267) sync output, and preserves the risetime of the sync. Q3252, another emitter-follower, provides the trigger to the Slow Sweep (Option 7), when it is included in the instrument.

R3262 is the Burst Gate Timing adjustment, which allows the exact matching of the burst gate (on the regenerated sync) to the burst location on normal video.

Frame-Pulse Generator PAL and PAL-M (Only)

The output of the +Amplifier is applied to the emitter of Q3440 through series high-pass filter, R3441-C3342. A subcarrier-rate signal is routed from the collector of Q3440 to a non-inverting amplifier (Q3350-Q3351).

The output of Q3351 is coupled through CR3460 to the base of Q3460. The collector of Q3460 drives a diode gate (CR3360 and CR3461) with the subcarrier-rate signal. The diode gate requires three separate actions to enable it: the trailing edge of burst gate from U3267; the subcarrier-rate signal from Q3460 must be present; and the inhibit voltage from the Line Counter (diagram 8). The inhibit voltage is absent only on lines 6 and 319 in PAL modes, or field 3, line 8 and field 4, line 270 in PAL-M models.

At line 6 or 319, at the trailing edge of sync, the diode-gate is enabled and the signal from Q3460 turns off a Miller run-up circuit (Q3470). The collector of Q3470 ramps rapidly positive, stays there until the diode-gate is again inhibited (approximately 2 μs), and falls to about 0 V. The pulse generated is used to gate the Field-Gate Generator (diagram 8).

DIAGRAM 6
AFC/DIRECT SWITCHING & PULSE GENERATOR

Circuits on this diagram use composite sync from the Sync Stripper to generate positive- and negative-going line-rate pulses (designated +H and −H). These signals can be derived either directly from the regenerated composite sync (DIRECT), or locked to a phase-locked loop (AFC). The phase-locked loop is referenced to the line rate.

31 kHz Lock-Out

U3070A is a monostable multivibrator that locks out any half-line-rate pulses, such as equalizing pulses and vertical serrations. Its output is coupled to the error Amplifier circuit and the AFC Direct Switching circuit.

AFC Direct Switching

In the DIRECT SYNC operating mode, R3033 holds up the base of Q3230 to disable the AFC loop (Error Amplifier-Phase-Locked Oscillator). At this time, one input of U3040A (pin 1) is held high to gate the output of the 31 kHz Lock-Out stage (applied to U3040A pin 2) through to the H Pulse Generator gate (U3040B). The input of U3040D, an inverter, is also held high to provide the low level to U3040C required to lock-out the output of the Phase-Locked Oscillator and gate the H Pulse Generator with the 31 kHz Lock-Out signal (DIRECT SYNC).

When the AFC button is pushed, a ground is supplied to the inverter (U3040D), one input of U3040A (pin 1), and the anode end of CR3040. The latter lets the base of Q3230 go, which enables the AFC loop. The grounding of the inverter reverses the state of U3040C, and now the output of the Phase-Locked Oscillator is applied to the H Pulse Generator gate. The output of the 31 kHz Lock-Out stage is locked out, because of the grounding of U3040A, and the instrument is operating in the AFC SYNC mode.

Phase-Locked Oscillator

Q3020 and Q3120 form a Bowes oscillator that free-runs at about 16.5 kHz. The output frequency of the Bowes oscillator is altered by the error signal from U3120A pin 1, at the rate of about 70 Hz/volt. This oscillator is balanced with a duty factor of nearly 50%. The time of the positive-going portion of the waveform is determined by R3020 and C3021; the negative-going timing is determined by R3021 and C3021.

The oscillator frequency is changed by altering the apparent Vcc of the transistors. The higher the apparent Vcc, the higher the frequency.

The oscillator output is applied through emitter-follower Q3031, to a differentiator comprised of C3131 and R3032 and R3136. From the differentiator, the negative-going pulse (the negative-going edge of the oscillator output waveform) is applied to U3040C (pin 9) to gate the H Pulse Generator in AFC SYNC mode.

Error Amplifier

U3070A's output switches low at the leading edge of the line-sync pulse and stays low for about 48 μs, then switches high and waits for the next line-sync pulse. The output of U3070A drives Q3139 through C3136.

Q3139 is turned off by the negative-going edge, and stays off for about 2 μs. The time is determined by the charge time of C3136 through R3140. The 2 μs positive-going pulse at the collector of Q3139 is applied to the base of Q3141 as the phase-lock sampling pulse.

Q3141 is either on or off, depending on the state of comparator Q3151-Q3152. When the loop is locked, Q3152 is off for the first microsecond of the phase-lock sampling pulse, and on for the second microsecond. During the first half of the phase-lock sampling pulse, Q3151 provides Q3141 with a current source, discharging C3121 by the same amount as it was previously charged. During the second half of the phase-lock sampling pulse, the charge-path for the memory capacitor (C3121) is through the collector-to-base junction of Q3141. This junction has been forward-biased by the phase-lock sampling pulse, the emitter having no current path at this time.

The level on C3121 is applied through voltage-follower U3120B to Error Amplifier U3120A. U3120A compares the level applied to pin 2 with the reference at pin 3, and drives the oscillator. U3120A is rate-limited for noise immunity.

The +H pulse from the H Pulse Generator also drives the base of Q3140, which is normally on. The trailing edge of the +H pulse turns Q3140 off, and keeps it off until the base-voltage ramps far enough positive to allow it to turn back on (the time-constant is set by C3053, and R3040). The output of Q3140 switches current-switch Q3152-Q3151 at the trailing edge of the +H pulse.

When the current-switch changes states, Q3151 becomes a current-source for Q3141 and charges C3121 during the first half of the phase-lock sampling pulse.

If the Bowes oscillator is operating at too low a frequency, Q3151 supplies discharging current during more than one-half of the phase-lock sampling pulse, and C3121 winds up with a net negative charge.

H Pulse Generator

The H Pulse Generator consists of U3040B, the gate, and U3070B. U3070B is another one-shot multivibrator. Its output time is about 2 μs. The +H Pulse is taken from pin 10, the −H Pulse at pin 9. Both pulses are used in the sweep-generating circuits.

DIAGRAM 6 a

This diagram has the Field-Sync Generator (−V), 50/60 Hz Recognition circuit (for dual-standard instruments), 50-60 Hz Trigger Input Amplifier (Auxiliary Sync, Option 7), and the Field-Sync Timing Switch (Option 7).

Field-Sync Generator

U3190 is the Field-Sync Generator. A negative-going field-rate sync pulse (designated −V), about 30 μs in period, is generated by U3190 upon receipt of a negative-going reset pulse derived in the Vertical Integrator and Peak Detector circuit.

Q3290, the Vertical Integrator, is normally on. The relatively fast line-sync pulses cannot do much to bring Q3290 out of saturation. The broad field-sync pulses, however, can turn Q3290 off. Each field serration pulse removes some of the charge caused by the field-sync pulses on C3184, but the collector of Q3290 ramps up, step-by-step toward ground.

The ramp at the collector of Q3290 is peak-detected by CR3281 and C3281, following the last field serration-pulse. At this time, Q3280 is turned on to saturation. But, the ramp at the collector of Q3290 immediately falls back toward −15 V and Q3280 turns off. The output of Q3280 is a 5 V, negative-going, 30 μs pulse inverted at the collector of Q3390. The pulse is inverted again in Q3291 and applied to the reset input of the Field Sync Generator, U3190.

The Field Sync Generator is triggered by −H pulses from U3070B to cause free-run in the absence of field-sync pulses at approximately (but not exactly) field time.

50 Hz/60 Hz Recognition (NTSC and PAL Dual-Standard Models Only)

The output of Q3390 resets integrator U3380 to 0 volts. After the reset pulse is past, U3380B produces a positive-going ramp at pin 7. The ramp amplitude is determined by the time between reset pulses. For 60 Hz systems, the ramp amplitude is about +10 volts. For 50 Hz systems, it is about +12 volts.

The ramp is peak-detected by CR3480, C3470 and R3482. The detected level is compared to a reference voltage in U3380A. The reference level is +11 volts, set by R3374 and R3380. The output of U3380A is applied to three places, the Field-Sweep Generator (diagram 9) to change the sweep length as necessary, to the Line Counter (diagram 8) to change the line count, and to the 50 Hz/60 Hz indicator drivers Q3081 and Q3082.

If the input signal field-rate is 50 Hz, U3380A pin 1 is positive, turning on Q3081. If the input signal field-rate is 60 Hz, U3380A pin 1 is negative, turning on Q3082. Regenerated composite-sync is applied to positive peak-detector CR3050, R3050, and C3050. When sync is present, the collector of Q3150, the Sync Present Detector (diagram 6), is at about +5 volts. If there is no incoming signal, the collector of Sync Present Detector, Q3150 is low, forward-biasing CR3082, disabling the 50 Hz/60 Hz indicators, and switching on the AFC through CR3040 to Q3240, U3040A pin 1 and U3040D pins 12 and 13.

50-60 Hz Trigger Input Amplifier (Option 7 only)

The 50-60 Hz Trigger Input Amplifier consists of Q3272 and Q3273. Q3272 is a switch that is conducting hard during normal operation, and takes all of the available current, keeping Q3273 shut off. When 50-60 Hz triggering is selected (both INT and EXT SYNC buttons pressed), Q3272 goes out of conduction, permitting Q3273 to conduct. This provides the 50-60 Hz triggering signal to the Field Sync Generator as a reset pulse (through Q3290 and Q3291). In addition, this signal is routed to the Field Sync Switching lock-out multi.

Field Sync Switching (Option 7 only)

When either 50-60 Hz Triggering or SLOW SWEEP mode is used, it is necessary to alter the operation of the Field Sync Generator. Actual component switching is through Q3170 and Q3272 for 50-60 Hz Triggering, and Q9405 and Q9407 (on Slow Sweep Circuit board) for the SLOW SWEEP mode.

Altering the operation of the Field Sync Generator (U3190) is accomplished by changing the time constants used to regulate its period. In the normal operating mode of a 1480-Series Waveform Monitor, Q3170 is saturated to apply 5 volts to one end of R3273, which parallels R3183.

When 50-60 Hz Triggering mode is selected, Q3170 is released and the 5 volts is no longer applied to R3273, making R3183 the timing resistor for the Field Sync Generator. While U3190 is operating at this slower rate, it is necessary to reduce the repetition rate of the reset pulse. A lockout multi (U3268) is used for this purpose. Its trigger pulse is derived directly from the 50-60 Hz Triggering signal. Its output rate is one-half the input trigger-rate. Whenever the 50-60 Hz Triggering is activated, a lockout pulse is provided to the reset input of U3190 (pin 4), through Q3373 (an amplifier) and Q3372 (switching), to limit the resetting of the Field Sync Generator to every other reset pulse. Q3372 is off until 50-60 Hz Triggering mode is selected. It is turned on by grounding its base through the INT and EXT SYNC switch.

When SLOW SWEEP mode is used, U3190's period must be altered still further, and the field sync-pulse stretched to allow for recovery. This is done by using two switching-transistors on the Slow Sweep circuit board, Q9405 and Q9407.

In SLOW SWEEP mode, Q9405's base is grounded, causing it to saturate and proved 5 volts to one end of R3181. This places R3181 in parallel with the normal timing resistors, R3183 and R3273.

To stretch the field sync pulses, it is necessary to change the value of capacitance in the circuit. This is easily done by paralleling C3190 with C3088. In this case, the 5 volt dc power supply serves as the ac ground for C3088 when Q9405 is saturated.

The Reset function of U3190 (pin 4) must be disabled for SLOW SWEEP mode. This is done by having Q9407 saturate (ground its base), and apply 5 volts to the reset input, making the input reset impervious to incoming reset pulses.

DIAGRAM 7
DC RESTORER TIMING

The circuit on this diagram develop timing signals for the DC Restorer clamp pulse, and trigger the internal calibrator circuits.

DC Restorer Timing Logic

The DC Restorer Timing Logic circuit generates a 0.8 μs, 500 mV pulse that gates the DC Restorer Sampler (diagram 3). The gate-pulse can be timed for anyone of three positions on the video line by front-panel command.

Negative-going composite sync from the Sync Stripper (diagram 5) is inverted in U4280D and applied to U4280C. The +H pulse is applied to the other input of U4280C, and when the two inputs coincide, the output steps low, triggering monostable-multivibrator U4080A.

The output pulse width is dictated by front-panel switch setting. In any RESPONSE except LOW PASS, Q4070 is saturated, setting the junction of R4171 and R4172 at +5 volts. With the DC Restorer in BACK PORCH mode, the pulse width is a function of R4171, R4173, and C4170. The actual pulse width is about 6 μs, with the leading edge nearly coincident with the leading edge of the line sync pulse.

If the RESPONSE is set to LOW PASS, Q4070 is turned off by divider R4190 and R4191 (between ground and +15 V). At the same time, CR4170 is forward-biased, turning off Q4090. U4080A's output pulse-width is now about 8 μs, a function nearly coincident with the leading edge of the line sync pulse.

The output of U4080A is made wider in LOW PASS to allow for the slow rise and fall of the LOW PASS filter.

SYNC TIP restoration is disabled in LOW PASS because dc restoration takes place even during equalizing pulses. The LOW PASS filter is so slow that the equalizing pulses have no tip left.

The trailing edge of whichever pulse has been selected triggers the second monostable multivibrator, U4080B. The output of U4080B is the gate-pulse for the DC Restorer Sampler (diagram 3), and is about 0.8 μs in width, a function of R4270 and C4190.

The position of the gate-pulse is dependent on the width of the pulse from U4080A. In the SYNC TIP mode, the gate-pulse begins about 1 μs after the leading edge of line sync. In the BACK PORCH mode, the gate pulse begins about 1.5 μs after the trailing edge of line sync. In LOW PASS, the gate pulse begins about 3.5 μs after the trailing edge of line sync and SYNC TIP restoration is disabled.

Composite sync is routed through CR4390 to lock out the gate pulse during vertical pulses when using BACK PORCH restoration. When SYNC TIP restoration is in use, CR4190 is forward-biased by the conduction of Q4090, and the gate pulse is never locked out.

The gate pulse is supplied to the DC Restorer Sampler, Q1891 (diagram 3).

Calibrator Timing Logic

U4640B is a D-type flip-flop clocked by a one-half line-rate pulse from U4640A (diagram 9). The output of the Calibrator Timing Logic is a one-fourth line-rate squarewave. Output can only occur when the front-panel CAL button is pressed. At all other times, the Preset input (pin 10) of U4640B is at ground.

DIAGRAM 8
LINE COUNTER & FIELD SWEEPS GENERATOR

Circuits on this diagram recognize fields and frames, gate and generate the field-rate sweeps, and perform the digital line count.

Field Recognition

U4850D is used to sense coincidence of H and V (line and field) pulses. Coincidence occurs on even fields for NTSC and PAL-M and on odd fields for PAL scanning systems. When coincidence occurs U4850D provides a clear pulse (low) to synchronize U4860A to a half-field rate.

When the clear input of U4860A pulses low, its $\overline{Q}$ will go high until the leading edge of the next +V pulse at the beginning of the next field. The next field, U4860A will change state (go low) and remain in that state until the next +V pulse. This action provides a high for the field where line and field sync are coincident and a low for the non-coincident field.

U4770A is used for field coding. When operating in NTSC or PAL-M scanning systems, one input (pin 2) is held low by a jumper selected low. Since U4770A is used as a switchable inverter, the output of U4770A is high during NTSC or PAL-M even fields (1 and 3) and low during the odd fields. The opposite condition occurs in the PAL scanning system, where a jumper selected high is provided to U4770A pin 2.

In dual-standard instruments the high or low supplied to pin 2 of U4770A is controlled by the 50-60 Hz Recognition circuit on diagram 6a.

U4780D is used to compare the front panel field selection with the field coded output of U4770A. One pin of U4780D (pin 12) is held high for even fields and low for odd fields (2 and 4). The output of U4780D must be low, both inputs high, for the Line Counter to run.

Line Counter

U4880B pulls the clear inputs low to inhibit the Line Counter. In all operating modes, except RGB and ALL FIELDS, control of U4880B's output rests with the output of U4780D (whose operation was discussed earlier). In RGB and ALL FIELDS one input either pin 10 or 11 is held low to inhibit field recognition. In order to control when the Line Counter starts, field sync is supplied to Q4979 to provide a clear pulse during field sync time. At the beginning of field sync time the collector of Q4979 spikes low to clear the line counters for ALL FIELDS and RGB modes.

In order to use one line-counter for three different standards and the possible dual-standard applications, it is necessary to adjust its count. In 1480-Series Waveform Monitors, this is done with two Exclusive OR Gates and a two-input NAND Gate. In addition, a framing pulse to the Frame-Pulse Generator must be recovered at lines 6 and 319 (PAL) or 8 and 270 (PAL-M). In PAL-M instruments, a special PAL-M Count Recognition circuit is added; this circuit will be discussed later.

The initial condition for the line counter has a low on both the preset and clear inputs until field-sync time, when preset goes high at the end of the selected field and clear goes high at the beginning of the selected field. The next line-sync pulse after the preset and clear inputs have gone high will start the counter, which runs until the output of the ÷32 stage, (U4570A) makes the transition from high-to-low. This transition resets the RS flip-flop, made up of U4270A and U4460C, at line 24. Preset goes negative for the remainder of the field (until the RS flip-flop is set by the field-sync pulse, −V).

The Exclusive OR Gates are used as programmable inverters to change the count as required for the various standards. For example, NTSC requires a change in polarity at the output of U4670A, but no change at the output of U4580A. PAL needs a change of polarity at the output of U4580A and on even fields does not need to change the polarity at the output of U4670A. PAL-M needs a change of polarity at the output of U4580A. The selection of input to the Exclusive OR Gates is through the program jumpers (A through R).

In the PAL (four-field system) standards, it is necessary to identify all four PAL fields. This is done by creating a special frame pulse on lines 6 or 319 (8 or 270 PAL-M). When all five of the diode gates used to identify lines 6 or 319 (CR4690, CR4691, CR4592, CR4590, and CR4591) are reverse-biased, an enable pulse is sent to the Frame-Pulse Generator (diagram 5). This pulse is generated only on line 319 of field 2 or line 6 of field 3.

PAL-M Count Recognition

The purpose of this circuit is to provide the enable pulse to the Frame-Pulse Generator (diagram 5) on lines 8 or 270 (or in the event of a PAL, PAL-M dual-standard, lines 6 or 319 also). The frame pulse enable is needed on fields 3 and 4; line 8 on field 3 and line 270 on field 4.

Generation of the pulse is complicated by the fact that the counters are all low for line 270 and all high for line 8. This requires an extra Exclusive OR Gate to identify even and odd fields, U8035B. As with the PAL standard, the enable pulse is generated when all five gating diodes are reverse-biased. The gating diodes are CR8035, CR8037, CR8036, CR8029, and CR8038.

Frame Recognition (PAL instruments only)

The frame pulses generated at line 319 field 2 or line 6 field 3 are inverted by U4850A and applied as a clear to U4860B. U4860B is clocked by the field gate (except when line-rate sweeps are being displayed). When the frame pulse is on field 2, fields 2 and 3 are high; fields 1 and 4 are low. When the frame pulse is on field 3, fields 3 and 4 are high and fields 1 and 2 are low. For PAL-M, U8007B (PAL-M Count Recognition circuit) is used to invert the output of U4860B so that it matches the output for PAL. U4660B is another Exclusive OR Gate whose output will be high when the line-selector functions are off, and low when the line selector is in use. Its output is applied to one input of U4740C. U4740C controls the gating of U4760A. The output of U4760A is the field gate to clock U4860B. U4760A is enabled in all conditions except a line-rate display with the LINE SELECTOR OFF pushbutton pressed.

Field Gate

The actual gate for the Field-Sweep Generator is the output of U4880A. U4880A is a NAND Gate that ANDS the output of the ÷16 counter (U4570B), the ÷32 counter (U4570A) and the Preset pulse. This produces a negative-going pulse that lasts from line 8 to line 16.

U4770D and U4880C make the decisions on which field to start the Field-Sweep Generator. U4770D has one input connected to the Frame Recognition ÷2 counter and the other input connected to the front-panel FIELD switching. If the even fields (1 and 3) are selected, the pin 12 input will be high. If the odd fields (2 and 4) are selected, it will be low. Pin 12 of U4770D will also be grounded if either field 1 or 4 is selected individually. If operating in either the EVEN or ODD mode, field selection is up to the Field Recognition circuit discussed earlier.

When a single field is to be displayed, both Field Recognition and Frame Recognition circuits are used. The field-gate will only be present in either even or odd fields (not both) as selected by the Field Recognition circuit. The inputs to U4770D will decide which field will be displayed.

Let's assume that PAL field 3 is to be displayed. The Field Recognition circuit will clear the counter for even fields (1 or 3) only, so field-gate pulses (from U4880A) will only be generated for fields 1 or 3. Frame-recognition pulses from the Frame-Pulse Generator (diagram 5) are arriving to clear U4860B only in fields 2 or 3. If the FIELD 1 button is pressed, one input to U4770D (pin 12) is grounded. When pin 13 goes low, U4770D's output goes low. This low is gated by U4880C and applied to one input of U4850B. The other input of U4850B has the field-gate pulse, which is low during the gate time (line 8 to line 16 of fields 1 and 3). The output of U4850B will be high during the gate time, but at the end of gate, the pin 4 input goes high, which causes the output to invert and provide a low to U4930C's pin 8 input. The other input to U4930C (pin 9) is held high, causing the input to pin 8 to be inverted and provide the desired high to the gate input of the Field-Sweep Generator. See the timing diagram, Fig. 9-1.

Field Sweep Generator

U4810 is an integrated-circuit sweep generator. Sweep is reset to 0 V whenever the gate input (pin 1) is low. When the gate input is high, the sweep ramps up toward 10 V at a rate dictated by the external timing elements. C4801 is the timing capacitor, charged by timing resistor R4713, which is reconfigured by Q4720 and R4719 (50 Hz) or Q4819 and R4712 (Slow Sweep Option 7 or Tone Wheel Sync Option 4 and 5).

Q4720 is saturated for 60 Hz operation, and off for 50 Hz. In its 'off' condition, R4719 is placed in series with R4713 to lengthen sweep time.

U4840A, Q4832, and U4930C provide switching for options 4, 5, 6, and 7.

U4930D is the input for Slow Sweep and Tone Wheel Sync field-sweep triggers. Also, Q4820 saturates, saturating Q4819, placing R4712 in parallel with the 50/60 Hz timing resistors to decrease the field sweep time.

Pin 8 of U4810 is the sweep output, a positive-going ramp.

U4810 pin 6 is an offset input. A voltage change at this point moves the delayed gate in time with respect to the sweep-output ramp. The delayed-gate output is pin 4, which is enabled by a high on pin 5. Pin 5 is grounded when the digital line-selector is used. Q4710 is an inverting amplifier. R4704 is used to feedback a small offset voltage to ensure that the gate occurs on a stable part of the sweep.

50-60 Hz Trigger Amplifier (Option 7 Only)

Q4910 and Q4911 form an operational amplifier that is driven by the −V pulse from the Field-Sync Generator (diagram 6a). The output from Q4910 provides one input to U4930D, which is used to reset the Field-Sweep Generator in 50-60 Hz trigger operation.

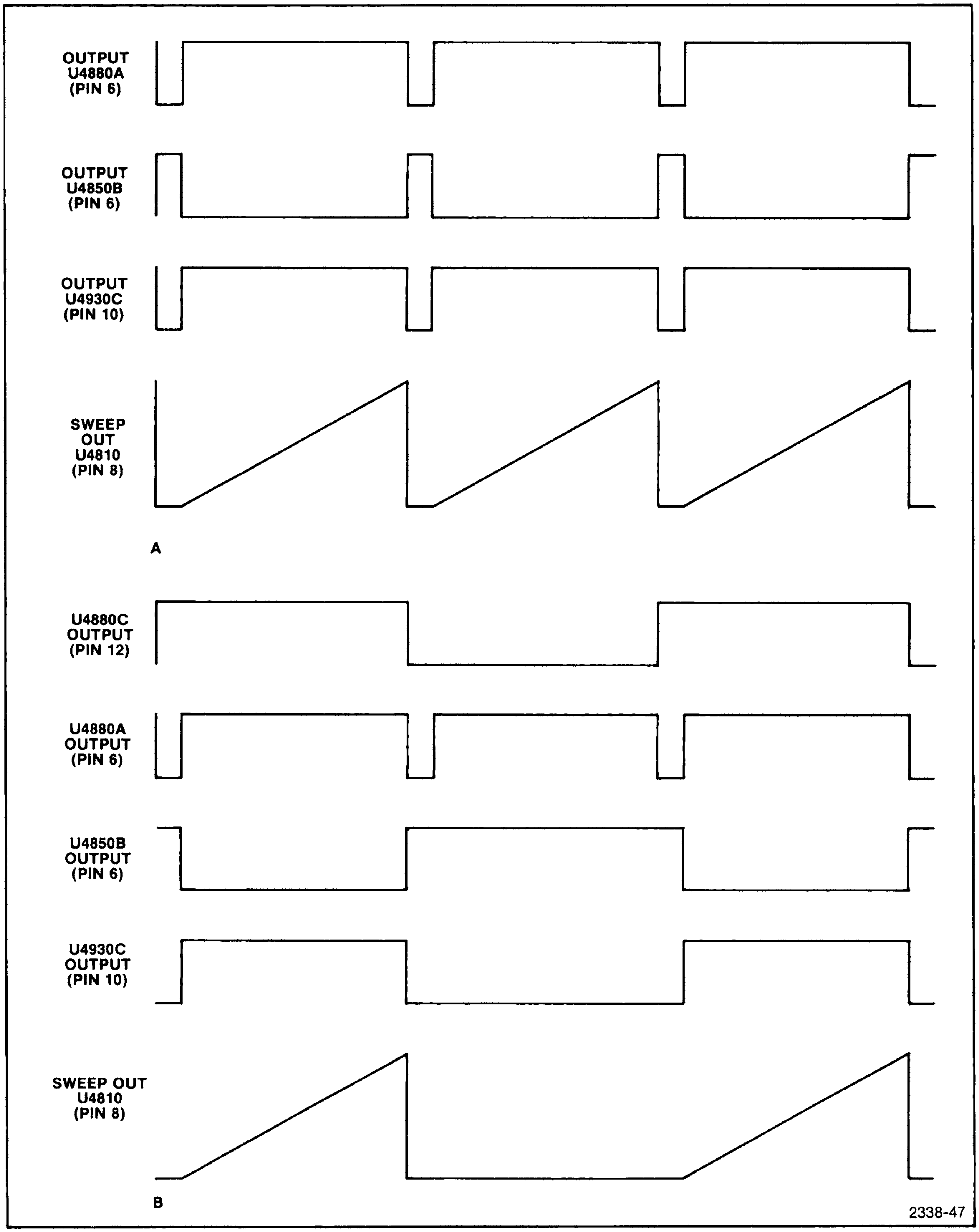
OUTPUT U4880A (PIN 6)
OUTPUT U4850B (PIN 6)
OUTPUT U4930C (PIN 10)
SWEEP OUT U4810 (PIN 8)
A
U4880C OUTPUT (PIN 12)
U4880A OUTPUT (PIN 6)
U4850B OUTPUT (PIN 6)
U4930C OUTPUT (PIN 10)
SWEEP OUT U4810 (PIN 8)
B
2338-47

Fig. 9-1. Field Sweep Generator Gating. A. Standard 2. Field display. B. Single Field (PAL or PAL-M).

DIAGRAM 9
LINE SELECTOR LOGIC AND LINE SWEEP GENERATOR

Circuits on this diagram include timing, start and stop controls for the LINE SELECTOR functions, gate generator, line-sweep generator, and unblanking drive.

Line Selector Logic

Digital line-selection is accomplished by U4680, an eight-input NAND Gate. U4680 delivers a line-length negative-going pulse when all of its inputs are high. U4780A, B, and C and U4660C are Exclusive OR Gates used to compare the counter output to the front-panel digital LINE SELECTOR code. Figure 9-2 shows the output from the Line counter. Switch inputs are shown on the Horizontal Switching diagram (16). Four of the inputs to U4680 are coupled to other enabling (disable) sources. Pin 2 will be high in all operations of the LINE SELECTOR except 15 LINES, pin 4 is high except in VARiable line-selection. Pin 5 is Line Counter Reset, and pin 12 is the Line Counter's ÷32 counter output. These latter inputs sense when the the counter is running.

The output of U4680 provides one reset input to U4560A and C, wired as a four-input RS flip-flop. The other reset input is the delayed-gate pulse from the Field-Rate Sweep, Q4710 (diagram 8). When operating in the VARiable LINE SELECTOR mode, the delayed-gate pulse, which goes low at the selected point on the field sweep, resets the flip-flop. This is also true of 15 LINES. In the DIGital mode, the output of Q4710 will be high and does not reset U4560A and C.

When U4560A and C resets, the $\overline{Q}$ output goes low and U4460A applies a high preset pulse to U4580B. U4580B is then clocked by the trailing edge of the −H pulse and generates the line-selector start pulse (Q output low and the $\overline{Q}$ output high). Both outputs are used.

The line-selector stop pulse is generated by U4550, a 4-bit binary counter, internally connected to provide ÷2, ÷4, ÷8, and ÷16 outputs. Only the pin 8 output is not used in this application. ÷4 is used to set U4560A and C in the 5 μs/DIV sweep through U4560B, while the ÷2 and ÷4 sets the flip-flop in the 10 μs/DIV sweep, through U4460B. In 15 LINES operation, both U4460B and U4560B are inhibited and the ÷16 output of U4550 (pin 11) is used to set U4560A and C.

U4580B provides the LINE STROBE from its Q output.

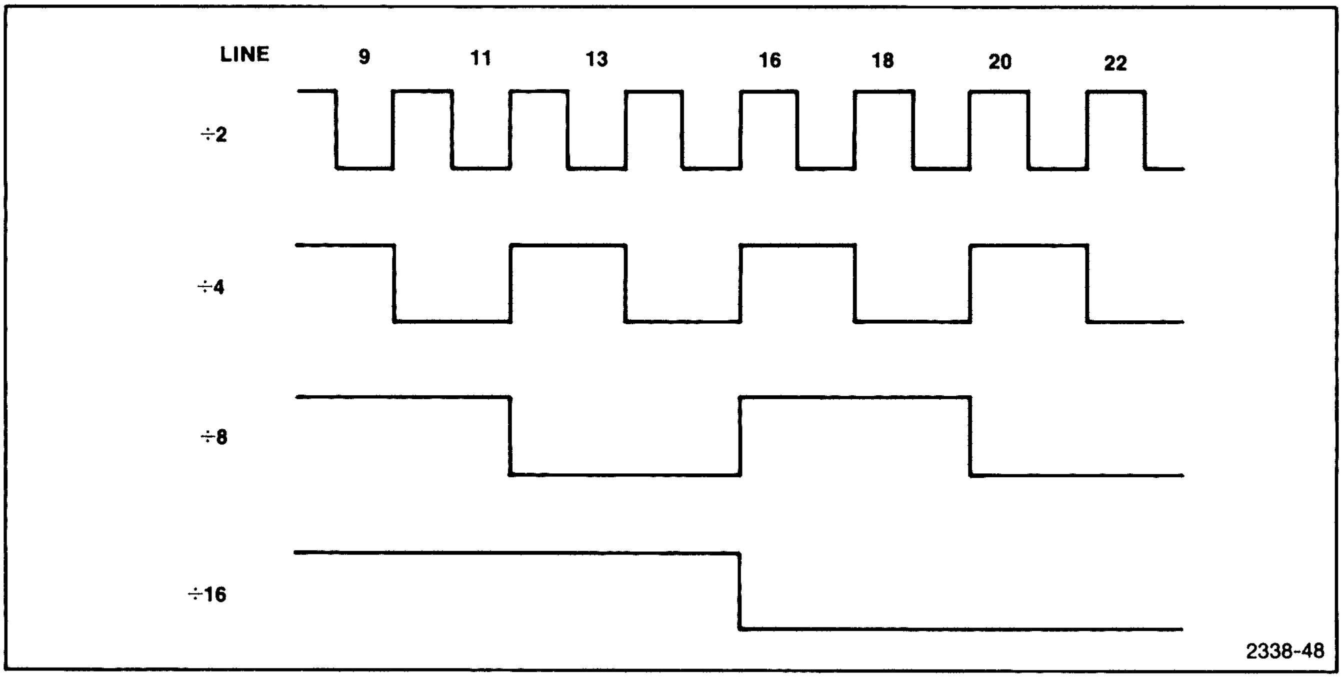

Fig. 9-2. Output of the Line Counter, for all standards.

Line Gate

The Line gate is required to deliver a high level to the Line-Sweep Generator for the sweep to run.

U4640A is a ÷2 flip-flop, counting down from the line rate (H rate). Its output is coupled through a series of gates to the input of the Line-Sweep Generator. Its preset is normally high, except when the cathodes of the three diodes, forming the input of a discrete open-collector NAND Gate, are high. This occurs when U4580B preset input and Q output are high and coincident with the +H pulse. This is used to align line-sweep and the unblanking to prevent the display of unwanted information preceding the selected line.

The one-half H-rate squarewave from U4640A is ANDED in U4740B with a switched-high (all times except RGB), and provides a high output every other line. When 10 μs/DIV sweep is selected, U4660D provides a low output except during the H pulse time (2 μs). During active display time in 10 μs/DIV, both inputs of U4740A are low, keeping a high on pin 1 of U4660A. In this sweep rate, the other input on U4660A is held permanently low. This combination provides a high input to the Line-Sweep Generator that is two lines long (127 μs). See timing diagram 9-3.

When 5 μs/DIV sweep rate is selected, the switched lows to U4660D and A are removed and those inputs go high, consequently reversing their operation. U4660D now provides a low output only during H Pulse time; it is high the rest of the normal line-time. U4660A now requires a low output from U4740A to initiate line sweep. This low can only occur on one-half of U4640A's duty cycle (1 line). The 5 μs/DIV sweep only runs on every other line. See Line-Gate timing diagram 9-3.

Two additional conditions must be covered at this time. In both RGB and 15-LINES displays, we want each line displayed. In normal operation at 5 μs/DIV, U4640A's duty cycle only allows the display of every other line. To handle RGB, one input of U4740B is grounded to keep the output of U4640A from affecting U4740B. This allows the +H signal to U4660D to become the sweep-gating signal. When the 15-LINES display is used at 5 μs/DIV sweep rate, U4760B provides a low to the preset for U4640A, causing the Q output to go low inhibiting U4640A, and again the line sweep is gated on by the +H signal.

Line Sweep Generator

The Line-Sweep Generator is U4440, a sweep generator integrated circuit, identical to the one used to generate the field sweeps. R4350 and C4341 provide the time-constant that dictates the ramp output's rate of rise (10 volts in 127 μs). For the 5 μs/DIV sweep rate, the ramp is only allowed to run-up to half amplitude (5 volts).

The ramp is enabled by a high at pin 1, conversely a low at pin 1 resets the ramp.

Pins 4, 5, and 6 are used to provide the delayed gate, used for the WAVEFORM COMPARISON LOCATE function. When WAVEFORM COMPARISON is activated (OVERLAY removed from detent), U4440 pin 5 goes high to enable the delayed gate. The location of the delayed-gate out is dependent on the offset voltage applied to pin 6. The offset voltage is divided down from the level set by the LOCATE control. R4340 and R4341 form a series divider for the 10 μs/DIV sweep rate. In the 5 μs/DIV sweep rate, R4352 is placed in parallel with R4340 to reduce the effect of the locate control in order to be compatible with the shortened sweep-ramp. (See Line Gate circuit description timing diagram 9-3.)

Unblanking

Two sources for unblanking are required, line and field. The determining factor in each source is the sweep-gating pulse being applied to the associated sweep generator.

In field blanking, U4930B is the gate that determines the unblanking. It requires two high levels to provide the enabling pulse to U4840D. When one of the field rate sweeps is used, the line unblanking is disabled by a ground applied to U4840B and U4930A. Field Blanking is enabled by removing the ground that is applied to U4930B in all modes of operation except field-rate sweeps. When the field sweep-gating pulse arrives at U4930B, a low output results. U4840D has one input held high all operating modes except External Horizontal. The low from U4930B inhibits U4840D, so a high pulse during sweep time occurs. This pulse is inverted by U4840C and becomes the unblanking pulse.

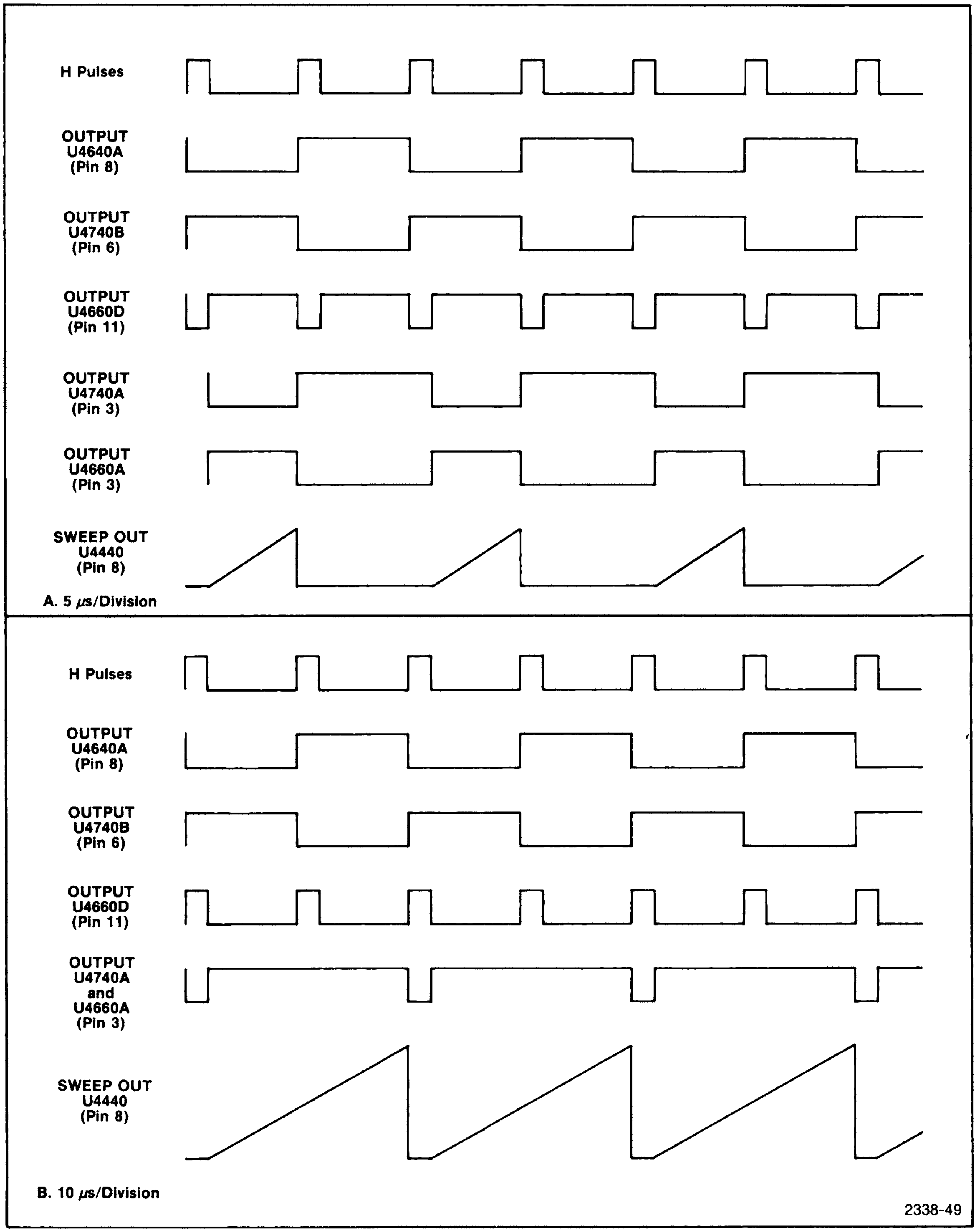
H Pulses
OUTPUT U4640A (Pin 8)
OUTPUT U4740B (Pin 6)
OUTPUT U4660D (Pin 11)
OUTPUT U4740A (Pin 3)
OUTPUT U4660A (Pin 3)
SWEEP OUT U4440 (Pin 8)
A. 5 µs/Division
H Pulses
OUTPUT U4640A (Pin 8)
OUTPUT U4740B (Pin 6)
OUTPUT U4660D (Pin 11)
OUTPUT U4740A and U4660A (Pin 3)
SWEEP OUT U4440 (Pin 8)
B. 10 µs/Division
2338-49

Fig. 9-3. Line Sweep Gating: A. 5 µs/Division. B. 10 µs/Division.

In the line sweeps (5 or 10 μs/DIV), the sweep-gating pulse from U4660A is NANDED with the $\overline{Q}$ output of the Line-Selector Start multi, U4580B, to provide a low from U4740D during sweep time. The output of U4740D inhibits U4840B providing high output during sweep time causing U4930A to produce the required low to initiate the unblanking pulse in U4840C.

Line unblanking for RGB is assured by pulling the clear input of the Line-Selector Start multi, U4580B, low to provide a constant high to U4740C.

DIAGRAM 10
HORIZONTAL SWITCHING LOGIC

Circuits on diagram 10 provide switching for the various horizontal inputs, a buffer amplifier to drive the Horizontal Magnifier, a Horizontal Positioning control circuit, and an input amplifier for RGB/YRGB operation.

Horizontal Switching

Horizontal switching is accomplished with six current switches, controlled by the front-panel DISPLAY and MAGNIFIER switching and RGB input from the rear-panel J9034 (RGB operation). Actual switching involves a pair of diodes per function. When a DISPLAY mode is selected, the switching diode is reverse-biased, which forward-biases the associated signal diode. For example, CR4132 is the field-sweep switching diode, and CR4030 the associated signal diode. When both of the inputs to U4260B are high, it reverse-biases CR4132, which forward-biases CR4030 and passes the field-rate ramp to the Horizontal Input Amplifier.

U4280A serves a dual purpose, not only is it used to switch the R_i for the 5 μs/DIV sweep, but it also switches the line sweep rate to 5 μs/DIV when a magnified sweep is selected. In field-rate sweep, both U4280A and U4260D are inhibited so that the field-rate ramp is applied to the Horizontal Input Amplifier.

The Horizontal Input Amplifier reacts to changes in its input current (signal currents), making it necessary to maintain constant current on the anodes of the signal diodes. Q4115 and Q4020 form a temperature compensated constant-current source. The −15 volt supply is metered for variations, and the output current (collector of Q4020A) is adjusted accordingly.

Horizontal Input Amplifier

The Horizontal Input Amplifier is an inverting operational amplifier, whose gain is unity for the field-rate sweep and the 10 μs/DIV sweep, and two for the 5 μs/DIV sweep. R_f for the operational amplifier is R4210, with C4210 as the amplifier high-frequency compensation. The selectable R_i are R4025 for the field-rate sweep, R4146 for the 10 μs/DIV sweep, and R4153 (one-half the value of R4146) for the 5 μs/DIV sweep. A gain of two is necessary in the 5 μs/DIV sweep to have a full-length sweep, because the output of the Line-Sweep Generator is only half of the amplitude of the 10 μs/DIV sweep ramp. Horizontal positioning current is applied at the base of Q4210A.

Horizontal Positioning

The horizontal positioning is a dc offset to the input of the Horizontal Input Amplifier. When the line sweeps are magnified, both ramps pass through R4153, the R_i for the 5 μs/DIV sweep. This doubles the sweep length for the 10 μs/DIV sweep and makes each of the lines displayed at this rate equal to the length of the line displayed at 5 μs/DIV. This accomplishes two things; removes the possiblity of an erroneous measurement due to a switch error, and allows the use of a single magnified scale. Because the sweep length of the 10 μs/DIV sweep is now double, it requires twice as much positioning current.

Q4211 and Q4310 are used to provide the additional horizontal-positioning current required in the 10 μs/DIV sweep rate, when it is magnified. When 10 μs/DIV sweep rate is magnified, the base of Q4211 is released from ground and its emitter is grounded. This turns Q4211 on. When on, Q4211 causes Q4310 to saturate and bypasses R4201, which is normally in series with the front-panel HORIZONTAL POSITION control, and the range of the control approximately doubles.

Q4230 is the WAVEFORM COMPARISON OVERLAY input. The delayed gate from U4440 (diagram 9) is applied to the base of Q4230, turning it off for the duration of the gate. Remember that the point at which the gate starts with respect to the ramp is controlled by the WAVEFORM COMPARISON LOCATE control.

The current supplied by the WAVEFORM COMPARISON OVERLAY control acts as positioning offset current during the time of the delayed gate only. In this manner, any portion of the ramp arriving at the Horizontal Input Amplifier can be overlayed with respect to the remainder of the ramp.

RGB Steps Input

When J9034 on the rear-panel is selected for RGB/YRGB input, the operation of both sweep generators is altered. In operation, the field-sweep generator is gated on every field, and in 10 μs/DIV or 5 μs/DIV, the Line-Sweep Generator is gated on every line. This means that the ramps are allowed to run to only 5-volts amplitude, instead of the 10 volts that is normal in 2 field and 10 μs/DIV.

For field RGB/YRGB operation, the R_i for the Horizontal Input Amplifier is R4134 (RGB) and R4134 + R4032 (YRGB). For line sweep, the R_i is R4250 (RGB) and R4250 + R4251 (YRGB).

The RGB/YRGB steps from J9034 are applied to the base of Q4051. Step amplitude requirement is for a 12-volt peak-to-peak series of symmetrical steps. Q4050 and Q4051 form a unity gain, inverting operational amplifier, so the output is 12 volts peak-to-peak applied to the Horizontal Amplifier through R4140 for 2 Field input or R4242 for 5 or 10 μs/DIV.

In RGB, the ramp amplitude at the output of the Horizontal Input Amplifier is one-third normal (one-half input-ramp amplitude times an amplifier gain of 0.67).

For YRGB, the ramp amplitude at the output of the Horizontal Input Amplifier is one-fourth normal (one-half input-ramp amplitude times an amplifier gain of 0.5).

DIAGRAM 11
HORIZONTAL AMPLIFIER

The circuits on diagram 11 provide for horizontal magnification, limiting, and amplification to the levels required to drive the crt deflection plates.

Horizontal Magnifier

Horizontal magnification is accomplished by changing the value of the emitter resistors to Q4323, part of an inverting amplifier whose gain ranges from 0.1 for unmagnified sweep to 5 for a X50 magnified sweep. With the MAGNIFIER off (X1), the bases of Q4312, Q4313, and Q4410 are ungrounded and the transistors are shut off; this makes R4223 the total emitter-resistance for Q4323.

In addition to the changing of the emitter resistances, the collector load of Q4411 is also changed between the unmagnified and magnified sweeps. When the MAGNIFIER is off, the base of Q4311 is grounded (through R4310) and the transistor is saturated, which grounds one end of R4420 to form a voltage divider with R4325. When one of the magnified-sweep positions is selected, R4310 is ungrounded, turning off Q4311 and removing R4420 from the circuit.

In the magnified positions, one or more of the three transistor switches (Q4312, Q4313, and Q4410) is saturated and a voltage divider with R4223 is formed.

Horizontal Limiter

The base of Q4522 is the input of the Horizontal Limiter Amplifier. Q4522 and Q4521 are a differential amplifier with a constant-current source (Q4540 and Q4531). R4532 in the emitter network is a gain control used to calibrate 10 μs/DIV timing.

Signal amplitude-limiting takes place between the collectors of Q4522 and Q4521. Q4520 sets the lower limit (left side of the crt) at about +12.6 volts. Q4530 sets the upper limit (right side of the crt) at about +17.5 volts. The left limit-control is R4330, the right limit-control is R4431. CR4424 and CR4428 are temperature compensating devices.

During unmagnified operation, the 5-volt range between limits is adequate to pass the entire ramp waveform. With the MAGNIFIER on, both limits are exceeded, with the result that the top and bottom of the ramp waveform (which is centered around +15 volts) are "chopped off". The rising portion between the limits is the portion of the sweep displayed on the crt.

Neither Q4521 or Q4522 is allowed to saturate at any time during this circuit's operation, thus avoiding the delay and linearity problems inherent in bringing transistors out of saturation.

VARiable MAGNIFIER (PAL Models Only)

R4532's function is paralleled by a VARiable MAGNIFIER control. Range of control is about 20%. When the VARiable MAGNIFIER is in use, a front-panel indicator lamp is lit.

Horizontal Deflection Amplifier

The Horizontal Deflection Amplifier is an operational amplifier with complementary outputs. The summing junction is the base of Q4510. R4240 in the Horizontal Limiter circuit supplies offset current to the summing junction and is adjusted for display centering in X5 magnification.

Q4500-4400 and Q4600-4601 provide the voltage swing necessary to drive the crt deflection plates. Each of these amplifiers is fed back to the summing junction for stability.

DIAGRAM 12
LOW VOLTAGE POWER SUPPLY

Circuits on this diagram provide the low voltages required to operate all of the 1480-Series circuits. Supplies are −15 V, +15 V, +75 V and +140 V.

−15 Volt Supply

U6060 is an integrated circuit error amplifier. Pins 4 and 5 are complementary inputs, with pin 4 the reference input, and pin 5 the feedback input. The error-amplifier output, pin 11, drives the base of Q6020, which in turn drives series-regulator, Q9600.

If the load-current increases, the supply tries to move positive (less negative). U6060 pin 11 then moves negative, causing the collector of Q6020 to move positive. The more positive level at the base of the series-regulator increases its current. If the load current decreases, the reverse takes place. The −15 Volts Supply is current limited by R6038 at about 600 mA.

R6034 and R6036 alter the voltage difference between U6060 pins 2 and 3 as the power-supply current begins to limit, providing for current foldback.

+15 Volt Supply

U6160 is an error amplifier, with complementary inputs at pins 4 and 5, and the output at pin 11. When the feedback input (pin 4) tries to change, the output moves with it, causing an opposite change at the collector of Q6120 and changing the current in Q9500, the series-regulator transistor. R6138 provides current limiting at, about 600 mA.

+75 Volt Supply

Q6260A and B is a differential amplifier with the base of A reference input. If the current-load on the supply increases, the supply tries to move in a negative direction, increasing the current in Q6235. The more positive level at the base of Q6230 causes an increase in the conduction of Q9300, the series-regulator.

The +75 Volt Supply-current is limited when the drop across R6242 is large enough to start turning Q6235 off. At that time, current previously conducted by Q6235 is routed through CR6250.

+140 Volt Supply

The +140 Volt Supply is referenced to the +75 volt supply at the emitter of Q6326. Q6326 is both the comparator and the driver for the series-regulator transistor Q9200.

Current limiting is accomplished by the voltage drop across R6318 being sensed by Q6322. When this voltage drop is sufficient, Q6322 is turned on, turning off Q6326. R6235 and C6322 are oscillation suppressors, slowing the rate of change at the base of Q6322.

DIAGRAM 13
Z-AXIS LOGIC

Circuits on this diagram control the intensification of the crt display.

Z-Axis Logic

U6474 is a five-transistor array, with U6474E operating as a current source that drives two current-switches (U6474A and B, U6474C and D). The amount of current supplied by U6474E is dependent upon the setting of the front-panel INTENSITY control.

The INTENSITY control range is set by the divider resistors R6578, R6580, R6582, R6586, and R6584. As the sweep magnification is increased, the resistors in the divider are removed one-by-one, bringing the positive end of the INTENSITY control closer to ground, increasing the current in U6474E, and increasing crt beam current. The maximum current available to the two current switches from U6474E is adjusted by R6466 (Max, Intensity) in the emitter circuit of U6474E. In LINE SELECTOR modes, Q6586 is saturated for maximum intensification.

U6474A and B form the unblanking current-switch. Selection A is normally conducting. When the negative-going unblank command arrives (from diagram 9) section A switches off while section B switches on and supplies current to the summing junction of the Z-Axis Amplifier.

U6474C and D form the line-selector intensification current switch. U6474D conducts until the line-selector strobe pulse turns off. At that time, U6474C turns on and supplies additional current to the summing junction of the Z-Axis Amplifier.

Z-Axis Amplifier

The base of Q6560 is the input to an operational amplifier. The gain of the amplifier is input current times the feedback resistance, providing an output of about 18 volts for each mA of input current.

DIAGRAM 14
HIGH VOLTAGE POWER SUPPLY

Circuits on diagram 14 generate and control the acceleration potential for the crt and supply the +5 V used as Vcc by the 1480-Series TTL devices.

CRT Biasing

Bias applied to the grid of the crt is from the dc potential derived by rectifying a clipped sinewave that appears at the junction of CR6890 and R6888. The clipped sine wave is a result of an input from T6810 through R6754 and C6752 being limited by CR6678 and CR6680.

CR6680 limits the positive excursion of the input at a point set by R6680, the CRT Grid Bias control. CR6678 limits the negative excursion of the input to a point set by the output of the Z-Axis Amplifier. The bias on the crt grid then is the difference between the two limit-points.

High Voltage Oscillator

Q9180 is the High Voltage Oscillator, connected in a Hartley configuration. Oscillation is sustained by positive feedback from collector to base through the winding of T6810. C6425, through normally saturated Q6644, is the ac ground return for the base winding of T6810. L6510 and C6615 form a filter to prevent oscillations from appearing in the +75 Volt Supply.

High Voltage Regulator

U6535 is the regulator for the High Voltage Oscillator, adding to or subtracting from the bias current for Q9180. R6860A and R6860B form the feedback divider. The RC network between U6535 pin 6 and the negative input, pin 2 provides frequency-compensation for the regulating circuit.

If the high-voltage supply should go out of regulation, the signal at T6810 tap 22 increases in amplitude. The signal is half-wave rectified by CR6736, filtered by C6648, and applied to R6534 as reference voltage for Q6642. When the base of Q6642 is high enough to turn off normally-saturated transistor Q6644, the oscillator base-winding ac ground is removed, and the oscillator is shut down.

Acceleration Potential

The post-accelerator voltage is applied from T6810 through a 4X multiplier to the crt. The same transformer tap is also the source of cathode and grid potential. CR6942 rectifies the sinewave. The half-wave rectified voltage is then applied through a filter (C6848, R6946, C6860) to the crt cathode and the crt grid bias network. The voltage at the anode of CR6942 is also the elevating potential for the crt filaments.

The sinewave at T6810 (tap 18) is rectified by CR6738 and CR6742 and filtered by C6738. The level is then clamped at −150 volts by VR6646 and applied to the crt as mesh voltage.

R6860C and R6550 (diagram 13) provide automatic focus-voltage change for LINE SELECTOR operating modes.

+5 Volt Supply

CR6728 and CR6730 rectify the sinewave at T6810 taps 20 and 22. The resulting output is filtered by L6627, C6636, and L6546 and becomes Vcc to TTL circuits.

CRT Controls

TRACE ROTATION R9935, varies the current through the Trace Rotating coil, L9650, affecting both vertical and horizontal components of the display.

R6414, the Y-axis Align control, varies the current through L9350. Since this coil is physically located before the horizontal deflection plates, it affects only the vertical components of the display.

R6508, the Geometry control, varies the potential on the horizontal deflection plate shields, and controls the overall display geometry.

FOCUS control, R9882, along with the internal Astigmatism adjustment (R6503) controls display definition.

R6503, the Astigmatism adjustment, is set to provide the best display definition when the FOCUS control is at or near mid-range.

DIAGRAM 15
VERTICAL SWITCHING

This diagram covers the switching required to control the vertical amplifier and external sync input operations.

DC Restorer

SLOW DC RESTORER applies +15 V to the base of Q1793 (diagram 3) to add an additional time constant to the clamping circuit.

FAST DC RESTORER negates the other two positions and allows the clamp to operate with its fast time constant.

DC RESTORER OFF removes the grounds from the base of Q1483, causing it to saturate and reference the input of the Clamped Amplifier (diagram 3) to ground.

SYNC TIP sets the timing of the DC Restorer so that the clamp-gate pulse begins about 1 μs after the leading edge of sync.

BACK PORCH sets the clamp-gate pulse to occur about 1.5 μs after the trailing edge of sync.

Calibrator-voltage switching is also a function of the BACK PORCH—SYNC TIP restoration switching. One of the contacts on the SYNC TIP switch is required to supply the 1.00 V from the calibrator voltage-divider to the calibrator voltage-follower (diagram 1). The other voltage-selection contact on the SYNC TIP switch is activated when the BACK PORCH switch is pushed in and locked. It provides either 0.700 or 0.714 V, depending on the setting of S9955 (External Graticule switch) and the SCALE ILLUMination control switch.

CAL-OPER Switching

When the OPER pushbutton is in, and the CAL pushbutton is out, ground is applied to the DC Restorer switching and through the CAL and INPUT switches to the A, B or A−B switching-diodes (see diagram 1). When the CAL pushbutton is in, and the OPER pushbutton is out, ground is shifted to the calibrator switching diode, CR1321, and CR1204, +Amplifier holding-current switch (see diagram 1). When both the CAL and OPER switches are pressed in, the calibrator switching diode and the A Amplifier signal switching-diode are both switched to ground. See the diagram 1 Circuit Description for further discussion of this operating mode.

INPUT Switching

The primary purpose of the INPUT switch is to provide ground closures (for switching diodes) required to select INPUT source, see diagram 1 Circuit Description. When the rear-panel SYNC switch is in the EXT SYNC SWITCHED WITH INPUT SWITCH (A) OR (B) position, the selection of the EXTERNAL SYNC input is also determined by the position of the INPUT switch. The other position of the rear-panel SYNC switch (EXT SYNC ALWAYS A) ties in EXTERNAL SYNC A input regardless of the INPUT switch setting.

SCALE ILLUMination

The scale illumination is from a dc source (Q9700), which is an emitter-follower whose base is controlled by the SCALE ILLUM control. There are two separate sets of bulbs in the graticule illumination circuit, each set drawing approximately the same current for any setting of the SCALE ILLUM control. One set (of three in series) is used with the internal graticule; the other (two bulbs in parallel) lights the external graticule. Selection of graticule to be illuminated depends on position of the switch that is built into the SCALE ILLUM control.

RESPONSE and VOLTS FULL SCALE Switching

These two switches control the switching transistors that control the filtering and vertical-amplifier sensitivity. Switching is accomplished by a closure to ground. The ground is routinely switched through all positions of the RESPONSE and VOLTS FULL SCALE switches.

When DIFF'D STEP is selected, vertical sensitivity goes up about 5X.

VERTICAL POSITION and GAIN

The VERTICAL POSITION control provides the base voltage to one-half of paraphase amplifier Q1670 (diagram 3).

Base voltage to the other half of the paraphase amplifier is through a voltage divider consisting of either the GAIN or VAR (VOLTS FULL SCALE) controls and R1684 on diagram 3.

The VAR control is equipped with a switch to control the UNCAL light. Voltage for the UNCAL light is from +15 V.

DIAGRAM 16
HORIZONTAL SWITCHING

This diagram includes circuitry to select SYNC source and mode, field to start display, line to be displayed, and supply HORIZONTAL POSITION and WAVEFORM COMPARISON offset voltages.

Sync Switching

In the DIRECT SYNC mode, the AFC loop lacks the required activating pulse. In AFC, the inputs to U3040A and D and the anode of CR3040 are grounded to activate the AFC loop (diagram 6).

EXT grounds the cathodes of switching diodes CR3200 and CR3319 to switch in external sync from either the EXTERNAL SYNC A or B input (diagram 5).

INT grounds the emitter of switching diode CR3330 to switch in the internally stripped sync (diagram 5).

Field Switching

PAL system instruments require four-field selection, while the NTSC versions only need even (1 and 3)-and odd (2 and 4)-field selection. Selection is through a series of ground closures in conjunction with the Field Gate Generator (diagram 8).

To select the ALL FIELDS mode of operation, one of the LINE SELECTOR positions (other than OFF) must be selected, along with the center-two FIELD selection buttons. In the ALL FIELDS mode, additional ground closures, other and the ones normally used in the field-selection process, are required for U4880B, U4880C, U4840A (Option 7 only) and Q4820 (also Option 7).

HORIZONTAL POSITION and WAVEFORM COMPARISON

The HORIZONTAL POSITION control provides the positioning offset-current to the Horizontal Input Amplifier (diagram 10).

The WAVEFORM COMPARISON function consists of two controls, LOCATE and OVERLAY, and an indicator light.

LOCATE controls the delayed gate offset to the Line Sweep Generator (diagram 9).

OVERLAY controls the amplitude of the delayed gate signal that is applied to offset the sweep level and horizontal-positioning offset. All three of the currents are summed at the input to the Horizontal Input Amplifier (diagram 10).

The indicator light is lit whenever the OVERLAY control is switched out of the detent.

In addition, a ground to disable the Line-Sweep Generator delayed gate is applied to the enable input of U4440 when the OVERLAY control is in the switch detent.

MAGNIFIER

The MAGNIFIER switch has four separate functions. First, by supplying the ground closures required to turn on selected transistors, it controls the Horizontal Magnifier's gain (diagram 11). Secondly, it selects values on the INTENSITY control voltage divider to increase the range of the INTENSITY control (diagram 13). Thirdly, along with the DISPLAY switch, it controls the current-boost required for one-line magnified displays (Horizontal Input Amplifier diagram 10). And lastly, it controls the shift in the time base to 5 μs/division when the magnifier is turned on with the sweep rate at 10 μs/division.

VARIABLE MAGNIFIER

This is a detented control that changes the gain of the Horizontal Limiter (diagram 11) in PAL models only.

LINE SELECTOR

The LINE SELECTOR switch programs the Line Selector Logic (diagram 9) to digitally select the horizontal line to be displayed. The VARiable control provides a variable voltage to the offset input of the Field-Sweep Generator to allow the selection of the line or group of lines (15 LINES) to be displayed (diagram 8).

DIAGRAM 16a
DISPLAY AND LINE SELECTOR

This circuitry provides the ground closures to control the type of display and the selection of line or lines to be displayed.

LINE SELECTOR

Ground for control of the 15 LINES, DIGital, or VARiable functions is routed from the DISPLAY switch to the LINE SELECTOR switch. In the SLOW SWEEP positions of the DISPLAY switch, this ground path is open to disable the normal LINE SELECTOR functions. In LINE SELECTOR OFF or the SLOW SWEEP position of the DISPLAY switch, a ground is supplied to the Z-Axis Logic (Q6586 through diagram 14) to prevent a boost in intensity.

DISPLAY

This switch supplies the grounds to enable or disable the six display modes. The switch is expanded in Option 7 instruments to accommodate the SLOW SWEEP + and − POLARITY switching.

DIAGRAM 17
SLOW SWEEP
(OPTION 7)

This circuitry provides ramp generation, trigger polarity control, and unblanking for slow sweep operation.

Trigger

The trigger input stage of the slow-sweep generator is comprised of Q9410 and Q9415. This stage is wired as a comparator, with input to the base of Q9410, and the base of Q9415 held at about +5 V. Triggering polarity (+ or − transition) is selected by grounding the collector for the undesired polarity. C9421 and R9432 differentiate the trigger output.Q9431 controls triggering. If a triggering signal is present, the sweep is controlled by the trigger output; if not, the sweep free runs.

Sweep Reset

Sweep Reset is started when the sweep-ramp amplitude reaches 10 V. Q9433 turns on, turning off Q9423, which causes the disconnect diodes, CR9434 and CR9435, to turn on and terminate the ramp.

At this time, a long time constant (C9438-R9427) charges until turn-on of Q9423, when the disconnect diodes are turned off and the ramp starts again (free-run). When a trigger signal is present, Q9423 is turned on by Q9431 before the time constant has charged to a level high enough to turn on Q9423, making operation of the Ramp Generator synchronous with the incoming trigger signal (triggered).

Ramp Generator

U9443A is connected as an integrator with a positive-ramp output. Disconnect diodes are CR9434 and CR9435, controlled by the Sweep Reset circuit through U9443B (a voltage follower). Timing components that determine the rate of rise of the ramp are C9446, R9445 and R9891. R9891 selects the rate of rise between approximately 5 to 12 seconds, depending on its setting.

Q9450 is the sweep-output switch; its base is held at ground in all positions of the front-panel DISPLAY switch except + and − SLOW SWEEP. In the SLOW SWEEP positions, Q9450 saturates and the output ramp is supplied to the offset input of the Field Sweep Generator (diagram 8).

Unblanking

Q9458's base is kept at ground in all positions of the DISPLAY switch except SLOW SWEEP. When SLOW SWEEP is selected, Q9458 is saturated and the Line Strobe Pulse from diagram 9 is used as the Slow Sweep Unblanking Pulse.

Field Sync Switches

In Slow Sweep operation, it is necessary to alter the operation of the Field-Sync Generator (diagram 6). This is done by using a pair of saturated transistors (in SLOW SWEEP) to provide voltage to a timing resistor, and ac ground to a timing capacitor through Q9405, and setting the Reset of U3190 (diagram 6) high, through Q9407.

This increases the pulse rate from the generator for Slow Sweep. This sync signal is then passed to the Field Recognition and 50/60 Hz Amplifier on the Sweep board (diagram 8).

DIAGRAM 18
TONE WHEEL SYNC INPUT

Circuits on this diagram provide sweep enable, dc restorer disable, control sync switching, and divide T.W. Sync rate-by-two to ensure a full horizontal trace.

2 Field Sweep Enable. A ground at J9034 pin B is applied to U7160A pin 1 and U7160C pin 9. U7160A pin 3 is normally high if the front-panel DISPLAY switch is in 2 FIELD or EXT, and low if 5 μs/DIV or 10 μs/DIV have been selected. If the DISPLAY switch is in 5 μs/DIV or 10 μs/DIV, the ground at U7160A pin 1 switches U7160A pin 3 from low to high, causing a low output at U7160B pin 6. That low output is applied to the Horizontal Switching circuit (diagram 10) to inhibit the 5 μs/DIV or 10 μs/DIV sweep. At the same time U7160C pin 9 is also at ground. If the front-panel DISPLAY switch is in 2 FIELD or EXT, the ground has no effect. If, however, the DISPLAY switch is in 5 μs/DIV or 10 μs/DIV, the output of U7160C is switched from low to high. That high is applied to the Horizontal Switching circuit enabling the 2 FIELD sweep.

DC Restorer Control. Certain VTR measurements are made using signals that are not composite video. When these measurements (for instance FM Level, Velocity Error Correction, and Chrominance Amplitude Correction) are made, the dc restorer (diagram 3) must be turned off because there is no signal reference for the dc restorer.

When J9034 pin B is grounded, Q7100 is turned off, applying a positive voltage to the base of Q1483 (diagram 3). Q1483 saturates, inhibiting the dc restorer.

At the same time that Q1483 saturates, an added circuit on diagram 3 is enabled. This added circuit consists of U1820 and associated components, and is used to apply additional positioning current to the Gain Control circuit when Q7100 turns off. R1814 (on diagram 3) is adjusted for minimum trace shift when J9034 pin B is grounded.

Internal Sync Switch. Q7183 is normally off with the front-panel SYNC INT button pushed, and saturated with the front-panel SYNC EXT button pushed. With the SYNC EXT button pushed and J9034 pin J grounded, CR7170 is forward-biased, turning off Q7183, and switching the Int/Ext Sync Switching circuit (on diagram 5) to internal sync.

T. W. Sync Gate. With J9034 pin A open, Q7113 is off, allowing the 2-Field Sweep Gate on diagram 8 to operate as usual. When J9034 pin A is grounded, Q7113 is saturated applying a low to U4840A, pin 2. This switches the sweep-gating function from U4930C to U4930D. U4930D is gated by Tone-Wheel Sync from U7200.

The low at U4840A pin 2 also saturates Q4820 and Q4819. This places R4712 in parallel with R4713 (and R4719 for 50 Hz). This decreases field sweep time so that the Field Sweep Generator will yield a full 10 V ramp for the faster sync rate.

T.W. Sync ÷2. Q4911 and Q4910 on the Sweep board receive the Tone-Wheel Sync signal from the rear-panel AUX SYNC input. These two transistors form an inverting operational amplifier with an output-pulse amplitude of about 5 volts. The collector of Q4910 drives the clock inputs of ÷2 circuit U7200A and U7200B.

At the leading edge of the Tone-Wheel Sync pulse, U7200B pin 10 goes low. At the trailing edge of the Tone-Wheel Sync pulse, U7200A pin 5 changes states. If U7200A pin 5 is low when the Tone-Wheel Sync pulse arrives, U7200B pin 8 will go low, but will be reset high at the trailing edge of Tone-Wheel Sync by U7200A pin 5. The result is a pulse out at U7200B pin 8 for every two pulses in at the AUX SYNC connectors.

This pulse is passed to U4930D in the Field Sweep Generator (diagram 8).

REPLACEABLE ELECTRICAL PARTS

PARTS ORDERING INFORMATION

Replacement parts are available from or through your local Tektronix, Inc. Field Office or representative.

Changes to Tektronix instruments are sometimes made to accommodate improved components as they become available, and to give you the benefit of the latest circuit improvements developed in our engineering department. It is therefore important, when ordering parts, to include the following information in your order: Part number, instrument type or number, serial number, and modification number if applicable.

If a part you have ordered has been replaced with a new or improved part, your local Tektronix, Inc. Field Office or representative will contact you concerning any change in part number.

Change information, if any, is located at the rear of this manual.

ITEM NAME

In the Parts List, an Item Name is separated from the description by a colon (:). Because of space limitations, an Item Name may sometimes appear as incomplete. For further Item Name identification, the U.S. Federal Cataloging Handbook H6-1 can be utilized where possible.

ABBREVIATIONS

ACTR	ACTUATOR	PLSTC	PLASTIC
ASSY	ASSEMBLY	QTZ	QUARTZ
CAP	CAPACITOR	RECP	RECEPTACLE
CER	CERAMIC	RES	RESISTOR
CKT	CIRCUIT	RF	RADIO FREQUENCY
COMP	COMPOSITION	SEL	SELECTED
CONN	CONNECTOR	SEMICOND	SEMICONDUCTOR
ELCTLT	ELECTROLYTIC	SENS	SENSITIVE
ELEC	ELECTRICAL	VAR	VARIABLE
INCAND	INCANDESCENT	WW	WIREWOUND
LED	LIGHT EMITTING DIODE	XFMR	TRANSFORMER
NONWIR	NON WIREWOUND	XTAL	CRYSTAL

CROSS INDEX—MFR. CODE NUMBER TO MANUFACTURER

Mfr. Code	Manufacturer	Address	City, State, Zip
000HM	NEC ELECTRON, INC.	3120 CENTRAL EXPRESS WAY	SANTA CLARA, CA 95051
00853	SANGAMO ELECTRIC CO., S. CAROLINA DIV.	P.O. BOX 128	PICKENS, SC 29671
01121	ALLEN-BRADLEY COMPANY	1201 2ND STREET SOUTH	MILWAUKEE, WI 53204
01295	TEXAS INSTRUMENTS, INC. SEMICONDUCTOR GROUP	P.O. BOX 5012	DALLAS, TX 75222
02735	RCA CORPORATION, SOLID STATE DIVISION	ROUTE 202	SOMERVILLE, NY 08876
02777	HOPKINS ENGINEERING COMPANY	12900 FOOTHILL BLVD.	SAN FERNANDO, CA 91342
03508	GENERAL ELECTRIC COMPANY, SEMI-CONDUCTOR PRODUCTS DEPARTMENT	ELECTRONICS PARK	SYRACUSE, NY 13201
03888	KDI PYROFILM CORPORATION	60 S JEFFERSON ROAD	WHIPPANY, NJ 07981
04222	AVX CERAMICS, DIVISION OF AVX CORP.	P O BOX 867	MYRTLE BEACH, SC 29577
04713	MOTOROLA, INC., SEMICONDUCTOR PROD. DIV.	5005 E MCDOWELL RD,PO BOX 20923	PHOENIX, AZ 85036
07263	FAIRCHILD SEMICONDUCTOR, A DIV. OF FAIRCHILD CAMERA AND INSTRUMENT CORP.	464 ELLIS STREET	MOUNTAIN VIEW, CA 94042
08806	GENERAL ELECTRIC CO., MINIATURE LAMP PRODUCTS DEPARTMENT	NELA PARK	CLEVELAND, OH 44112
09023	CORNELL-DUBILIER ELECTRONIC DIVISION FEDERAL PACIFIC ELECTRIC CO.	2652 DALRYMPLE ST.	SANFORD, NC 27330
09353	C AND K COMPONENTS, INC.	103 MORSE STREET	WATERTOWN, MA 02172
12697	CLAROSTAT MFG. CO., INC.	LOWER WASHINGTON STREET	DOVER, NH 03820
12969	UNITRODE CORPORATION	580 PLEASANT STREET	WATERTOWN, MA 02172
14433	ITT SEMICONDUCTORS	3301 ELECTRONICS WAY P O BOX 3049	WEST PALM BEACH, FL 33402
14752	ELECTRO CUBE INC.	1710 S. DEL MAR AVE.	SAN GABRIEL, CA 91776
15238	ITT SEMICONDUCTORS, A DIVISION OF INTER NATIONAL TELEPHONE AND TELEGRAPH CORP.	P.O. BOX 168, 500 BROADWAY	LAWRENCE, MA 01841
17856	SILICONIX, INC.	2201 LAURELWOOD DRIVE	SANTA CLARA, CA 95054
18324	SIGNETICS CORP.	811 E. ARQUES	SUNNYVALE, CA 94086
19396	ILLINOIS TOOL WORKS, INC. PAKTRON DIV.	900 FOLLIN LANE, SE	VIENNA, VA 22180
19647	CADDOCK ELECTRONICS INC.	3127 CHICAGO AVENUE	RIVERSIDE, CA 92507
19701	ELECTRA-MIDLAND CORP., MEPCO ELECTRA INC.	P O BOX 760	MINERAL WELLS, TX 76067
24546	CORNING GLASS WORKS, ELECTRONIC COMPONENTS DIVISION	550 HIGH STREET	BRADFORD, PA 16701
27014	NATIONAL SEMICONDUCTOR CORP.	2900 SEMICONDUCTOR DR.	SANTA CLARA, CA 95051
27193	CUTLER-HAMMER, INC. SPECIALTY PRODUCTS DIVISION	4201 N. 27TH ST.	MILWAUKEE, WI 53216
31433	UNION CARBIDE CORP ELECTRONICS DIV	PO BOX 5928	GREENVILLE, SC 29606
32997	BOURNS, INC., TRIMPOT PRODUCTS DIV.	1200 COLUMBIA AVE.	RIVERSIDE, CA 92507
50157	MIDWEST COMPONENTS INC.	P. O. BOX 787 1981 PORT CITY BLVD.	MUSKEGON, MI 49443
51642	CENTRE ENGINEERING INC.	2820 E COLLEGE AVENUE	STATE COLLEGE, PA 16801
51984	NEC AMERICA INC. RADIO AND TRANSMISSION DIV.	2990 TELESTAR CT. SUITE 212	FALLS CHURCH, VA 22042
52306	HIGH VOLTAGE DEVICES, INC.	7485 AVENUE 304	VISALIA, CA 93277
54473	MATSUSHITA ELECTRIC, CORP. OF AMERICA	1 PANASONIC WAY	SECAUCUS, NJ 07094
55292	LEDCO DIV., WILBRECHT ELECTRONICS, INC.	240 EAST PLATO BLVD.	ST. PAUL, MN 55107
55680	NICHICON/AMERICA/CORP.	6435 N PROESEL AVENUE	CHICAGO, IL 60645
56289	SPRAGUE ELECTRIC CO.	87 MARSHALL ST.	NORTH ADAMS, MA 01247
57668	R-OHM CORP.	16931 MILLIKEN AVE.	IRVINE, CA 92713
59660	TUSONIX INC.	2155 N FORBES BLVD	TUCSON, AZ 85705
59821	CENTRALAB INC SUB NORTH AMERICAN PHILIPS CORP	7158 MERCHANT AVE	EL PASO, TX 79915
71400	BUSSMAN MFG., DIVISION OF MCGRAW-EDISON CO.	2536 W. UNIVERSITY ST.	ST. LOUIS, MO 63107
72982	ERIE TECHNOLOGICAL PRODUCTS, INC.	644 W. 12TH ST.	ERIE, PA 16512
73138	BECKMAN INSTRUMENTS, INC., HELIPOT DIV.	2500 HARBOR BLVD.	FULLERTON, CA 92634
74276	SIGNALITE DIV., GENERAL INSTRUMENT CORP.	1933 HECK AVE.	NEPTUNE, NJ 07753
74970	JOHNSON, E. F., CO.	299 10TH AVE. S. W.	WASECA, MN 56093
75042	TRW ELECTRONIC COMPONENTS, IRC FIXED RESISTORS, PHILADELPHIA DIVISION	401 N. BROAD ST.	PHILADELPHIA, PA 19108
76493	BELL INDUSTRIES, INC., MILLER, J. W., DIV.	19070 REYES AVE., P O BOX 5825	COMPTON, CA 90224
79727	C-W INDUSTRIES	550 DAVISVILLE RD.,P O BOX 96	WARMINISTER, PA 18974
80009	TEKTRONIX, INC.	P O BOX 500	BEAVERTON, OR 97077
80031	ELECTRA-MIDLAND CORP., MEPCO DIV.	22 COLUMBIA ROAD	MORRISTOWN, NJ 07960
82389	SWITCHCRAFT, INC.	5555 N. ELSTON AVE.	CHICAGO, IL 60630
83003	VARO, INC.	P O BOX 411, 2203 WALNUT STREET	GARLAND, TX 75040

CROSS INDEX—MFR. CODE NUMBER TO MANUFACTURER

Mfr. Code	Manufacturer	Address	City, State, Zip
90201	MALLORY CAPACITOR CO., DIV. OF P. R. MALLORY AND CO., INC.	3029 E. WASHINGTON STREET P. O. BOX 372	INDIANAPOLIS, IN 46206
91637	DALE ELECTRONICS, INC.	P. O. BOX 609	COLUMBUS, NE 68601
96733	SAN FERNANDO ELECTRIC MFG CO	1501 FIRST ST	SAN FERNANDO, CA 91341
T0891	MICONICS	1 FAIRCHILD AVE.	PLAINVIEW, NY 11803

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A1	670-3486-00			CKT BOARD ASSY:VERTICAL SWITCH	80009	670-3486-00
A1-1	670-3491-00	B060000	B093336	CKT BOARD ASSY:PROBE AMP & VERT SW	80009	670-3491-00
A1-1	----- -----			(OPTION 01 ONLY)		
A1-1	670-3491-01	B093337		CKT BOARD ASSY:PROBE AMP & VERT SW	80009	670-3491-01
A1-1	----- -----			(OPTION 01 ONLY)		
A2	670-3485-06	B060000	B062198	CKT BOARD ASSY:VERTICAL AMPLIFIER	80009	670-3485-06
A2	----- -----			(1480C ONLY)		
A2	670-3485-12	B062199	B069999	CKT BOARD ASSY:VERTICAL AMPLIFIER	80009	670-3485-12
A2	----- -----			(1480C ONLY)		
A2	670-3485-18	B070000	B073693	CKT BOARD ASSY:VERTICAL AMPLIFIER	80009	670-3485-18
A2	----- -----			(1480C ONLY)		
A2	670-3485-23	B073694	B079999	CKT BOARD ASSY:VERTICAL AMPLIFIER	80009	670-3485-23
A2	----- -----			(1480C ONLY)		
A2	670-3485-29	B080000	B084040	CKT BOARD ASSY:VERTICAL AMPLIFIER	80009	670-3485-29
A2	----- -----			(1480C ONLY)		
A2	670-3485-34	B084041	B094089	CKT BOARD ASSY:VERTICAL AMPLIFIER	80009	670-3485-34
A2	----- -----			(1480C ONLY)		
A2	670-3485-39	B094090		CKT BOARD ASSY:VERTICAL AMPLIFIER	80009	670-3485-39
A2	----- -----			(1480C ONLY)		
A2	670-3485-06	B060000	B065886	CKT BOARD ASSY:VERTICAL AMPLIFIER	80009	670-3485-06
A2	----- -----			(1480R ONLY)		
A2	670-3485-12	B065887	B069999	CKT BOARD ASSY:VERTICAL AMPLIFIER	80009	670-3485-12
A2	----- -----			(1480R ONLY)		
A2	670-3485-18	B070000	B081953	CKT BOARD ASSY:VERTICAL AMPLIFIER	80009	670-3485-18
A2	----- -----			(1480R ONLY)		
A2	670-3485-23	B081954	B089999	CKT BOARD ASSY:VERTICAL AMPLIFIER	80009	670-3485-23
A2	----- -----			(1480R ONLY)		
A2	670-3485-29	B090000	B093819	CKT BOARD ASSY:VERTICAL AMPLIFIER	80009	670-3485-29
A2	----- -----			(1480R ONLY)		
A2	670-3485-34	B093820	B104064	CKT BOARD ASSY:VERTICAL AMPLIFIER	80009	670-3485-34
A2	----- -----			(1480R ONLY)		
A2	670-3485-39	B104065		CKT BOARD ASSY:VERTICAL AMPLIFIER	80009	670-3485-39
A2	----- -----			(1480R ONLY)		
A2	670-3485-09	B060000	B062198	CKT BOARD ASSY:VERTICAL AMPLIFIER	80009	670-3485-09
A2	----- -----			(1481C,1482C,1485C ONLY)		
A2	670-3485-15	B062199	B069999	CKT BOARD ASSY:VERTICAL AMPLIFIER	80009	670-3485-15
A2	----- -----			(1481C,1482C,1485C ONLY)		
A2	670-3485-21	B070000	B073693	CKT BOARD ASSY:VERTICAL AMPLIFIER	80009	670-3485-21
A2	----- -----			(1481C,1482C,1485C ONLY)		
A2	670-3485-26	B073694	B079999	CKT BOARD ASSY:VERTICAL AMPLIFIER	80009	670-3485-26
A2	----- -----			(1481C,1482C,1485C ONLY)		
A2	670-3485-32	B080000	B084040	CKT BOARD ASSY:VERTICAL AMPLIFIER	80009	670-3485-32
A2	----- -----			(1481C,1482C 1485C ONLY)		
A2	670-3485-37	B084041	B094089	CKT BOARD ASSY:VERTICAL AMPLIFIER	80009	670-3485-37
A2	----- -----			(1481C,1482C 1485C ONLY)		
A2	670-3485-42	B094090		CKT BOARD ASSY:VERTICAL AMPLIFIER	80009	670-3485-42
A2	----- -----			(1481C,1482C 1485C ONLY)		
A2	670-3485-09	B060000	B065886	CKT BOARD ASSY:VERTICAL AMPLIFIER	80009	670-3485-09
A2	----- -----			(1481R,1482R,1485R ONLY)		
A2	670-3485-15	B065887	B069999	CKT BOARD ASSY:VERTICAL AMPLIFIER	80009	670-3485-15
A2	----- -----			(1481R,1482R,1485R ONLY)		
A2	670-3485-21	B070000	B081953	CKT BOARD ASSY:VERTICAL AMPLIFIER	80009	670-3485-21
A2	----- -----			(1481R,1482R,1485R ONLY)		
A2	670-3485-26	B081954	B089999	CKT BOARD ASSY:VERTICAL AMPLIFIER	80009	670-3485-26
A2	----- -----			(1481R,1482R,1485R ONLY)		

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A2	670-3485-32	B090000	B093819	CKT BOARD ASSY:VERTICAL AMPLIFIER	80009	670-3485-32
A2	----- -----			(1481R,1482R,1485R ONLY)		
A2	670-3485-37	B093820	B104064	CKT BOARD ASSY:VERTICAL AMPLIFIER	80009	670-3485-37
A2	----- -----			(1481R,1482R,1485R ONLY)		
A2	670-3485-42	B104065		CKT BOARD ASSY:VERTICAL AMPLIFIER	80009	670-3485-42
A2	----- -----			(1481R,1482R,1485R ONLY)		
A2	670-3485-07	B060000	B062198	CKT BOARD ASSY:VERTICAL AMPLIFIER	80009	670-3485-07
A2	----- -----			(1480C,1482C OPTION 04.		
A2	----- -----			1485C OPTION 05)		
A2	670-3485-13	B062199	B069999	CKT BOARD ASSY:VERTICAL AMPLIFIER	80009	670-3485-13
A2	----- -----			(1480C,1482C OPTION 04,		
A2	----- -----			1485C OPTION 05)		
A2	670-3485-19	B070000	B073693	CKT BOARD ASSY:VERTICAL AMPLIFIER	80009	670-3485-19
A2	----- -----			(1480C,1482C OPTION 04.		
A2	----- -----			1485C OPTION 05)		
A2	670-3485-24	B073694	B079999	CKT BOARD ASSY:VERTICAL AMPLIFIER	80009	670-3485-24
A2	----- -----			(1480C,1482C OPTION 04.		
A2	----- -----			1485C OPTION 05)		
A2	670-3485-30	B080000	B084040	CKT BOARD ASSY:VERTICAL AMPLIFIER	80009	670-3485-30
A2	----- -----			(1480C,1482C OPTION 04.		
A2	----- -----			1485C OPTION 05)		
A2	670-3485-35	B084041	B094089	CKT BOARD ASSY:VERTICAL AMPLIFIER	80009	670-3485-35
A2	----- -----			(1480C,1482C OPTION 04.		
A2	----- -----			1485C OPTION 05)		
A2	670-3485-40	B094090		CKT BOARD ASSY:VERTICAL AMPLIFIER	80009	670-3485-40
A2	----- -----			(1480C,1482C OPTION 04.		
A2	----- -----			1485C OPTION 05)		
A2	670-3485-10	B060000	B062198	CKT BOARD ASSY:VERTICAL AMPLIFIER	80009	670-3485-10
A2	----- -----			(1481C,1485C OPTION 04 ONLY)		
A2	670-3485-16	B062199	B069999	CKT BOARD ASSY:VERTICAL AMPLIFIER	80009	670-3485-16
A2	----- -----			(1481C,1485C OPTION 04 ONLY)		
A2	670-3485-22	B070000	B073693	CKT BOARD ASSY:VERTICAL AMPLIFIER	80009	670-3485-22
A2	----- -----			(1481C,1485C OPTION 04 ONLY)		
A2	670-3485-27	B073694	B079999	CKT BOARD ASSY:VERTICAL AMPLIFIER	80009	670-3485-27
A2	----- -----			(1480C,1485C OPTION 04 ONLY)		
A2	670-3485-33	B080000	B084040	CKT BOARD ASSY:VERTICAL AMPLIFIER	80009	670-3485-33
A2	----- -----			(1480C,1485C OPTION 04 ONLY)		
A2	670-3485-38	B084041	B084089	CKT BOARD ASSY:VERTICAL AMPLIFIER	80009	670-3485-38
A2	----- -----			(1480C,1485C OPTION 04 ONLY)		
A2	670-3485-43	B094090		CKT BOARD ASSY:VERTICAL AMPLIFIER	80009	670-3485-43
A2	----- -----			(1480C,1485C OPTION 04 ONLY)		
A3	670-3489-00			CKT BOARD ASSY:HORIZONTAL SWITCH	80009	670-3489-00
A4	670-3488-03	B060000	B062268	CKT BOARD ASSY:SWEEP OUTPUT	80009	670-3488-03
A4	----- -----			(1480C ONLY)		
A4	670-3488-11	B062269	B073261	CKT BOARD ASSY:SWEEP OUTPUT	80009	670-3488-11
A4	----- -----			(1480C ONLY)		
A4	670-3488-15	B073262	B073292	CKT BOARD ASSY:SWEEP OUTPUT	80009	670-3488-15
A4	----- -----			(1480C ONLY)		
A4	670-3488-19	B073293	B073580	CKT BOARD ASSY:SWEEP OUTPUT	80009	670-3488-19
A4	----- -----			(1480C ONLY)		
A4	670-3488-22	B073581	B073731	CKT BOARD ASSY:SWEEP OUTPUT	80009	670-3488-22
A4	----- -----			(1480C ONLY)		
A4	670-3488-24	B073732	B084040	CKT BOARD ASSY:SWEEP OUTPUT	80009	670-3488-24
A4	----- -----			(1480C ONLY)		

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A4	670-3488-30	B084041	B094089	CKT BOARD ASSY:SWEEP OUTPUT	80009	670-3488-30
A4	----- -----			(1480C ONLY)		
A4	670-3488-34	B094090		CKT BOARD ASSY:SWEEP OUTPUT	80009	670-3488-34
A4	----- -----			(1480C ONLY)		
A4	670-3488-03	B060000	B066123	CKT BOARD ASSY:SWEEP OUTPUT	80009	670-3488-03
A4	----- -----			(1480R ONLY)		
A4	670-3488-11	B066124	B079761	CKT BOARD ASSY:SWEEP OUTPUT	80009	670-3488-11
A4	----- -----			(1480R ONLY)		
A4	670-3488-15	B079762	B080412	CKT BOARD ASSY:SWEEP OUTPUT	80009	670-3488-15
A4	----- -----			(1480R ONLY)		
A4	670-3488-19	B080413	B081486	CKT BOARD ASSY:SWEEP OUTPUT	80009	670-3488-19
A4	----- -----			(1480R ONLY)		
A4	670-3488-22	B081487	B082415	CKT BOARD ASSY:SWEEP OUTPUT	80009	670-3488-22
A4	----- -----			(1480R ONLY)		
A4	670-3488-24	B082414	B093819	CKT BOARD ASSY:SWEEP OUTPUT	80009	670-3488-24
A4	----- -----			(1480R ONLY)		
A4	670-3488-30	B093820	B104064	CKT BOARD ASSY:SWEEP OUTPUT	80009	670-3488-30
A4	----- -----			(1480R ONLY)		
A4	670-3488-34	B104065		CKT BOARD ASSY:SWEEP OUTPUT	80009	670-3488-34
A4	----- -----			(1480R ONLY)		
A4	670-3488-05	B060000	B061354	CKT BOARD ASSY:SWEEP OUTPUT	80009	670-3488-05
A4	----- -----			(1481C ONLY)		
A4	670-3488-15	B061355	B073388	CKT BOARD ASSY:SWEEP OUTPUT	80009	670-3488-15
A4	----- -----			(1481C ONLY)		
A4	670-3488-19	B073389	B073579	CKT BOARD ASSY:SWEEP OUTPUT	80009	670-3488-19
A4	----- -----			(1481C ONLY)		
A4	670-3488-22	B073580	B073731	CKT BOARD ASSY:SWEEP OUTPUT	80009	670-3488-22
A4	----- -----			(1481C ONLY)		
A4	670-3488-24	B073732	B084040	CKT BOARD ASSY:SWEEP OUTPUT	80009	670-3488-24
A4	----- -----			(1481C ONLY)		
A4	670-3488-30	B084041	B094089	CKT BOARD ASSY:SWEEP OUTPUT	80009	670-3488-30
A4	----- -----			(1481C ONLY)		
A4	670-3488-34	B094090		CKT BOARD ASSY:SWEEP OUTPUT	80009	670-3488-34
A4	----- -----			(1481C ONLY)		
A4	670-3488-05	B060000	B073261	CKT BOARD ASSY:SWEEP OUTPUT	80009	670-3488-05
A4	----- -----			(1481R ONLY)		
A4	670-3488-15	B073262	B080426	CKT BOARD ASSY:SWEEP OUTPUT	80009	670-3488-15
A4	----- -----			(1481R ONLY)		
A4	670-3488-19	B080427	B081484	CKT BOARD ASSY:SWEEP OUTPUT	80009	670-3488-19
A4	----- -----			(1481R ONLY)		
A4	670-3488-22	B081485	B082415	CKT BOARD ASSY:SWEEP OUTPUT	80009	670-3488-22
A4	----- -----			(1481R ONLY)		
A4	670-3488-24	B082414	B093819	CKT BOARD ASSY:SWEEP OUTPUT	80009	670-3488-24
A4	----- -----			(1481R ONLY)		
A4	670-3488-30	B093820	B104064	CKT BOARD ASSY:SWEEP OUTPUT	80009	670-3488-30
A4	----- -----			(1481R ONLY)		
A4	670-3488-34	B104065		CKT BOARD ASSY:SWEEP OUTPUT	80009	670-3488-34
A4	----- -----			(1481R ONLY)		
A4	670-3488-05	B060000	B061354	CKT BOARD ASSY:SWEEP OUTPUT	80009	670-3488-05
A4	----- -----			(1482C ONLY)		
A4	670-3488-15	B061355	B073321	CKT BOARD ASSY:SWEEP OUTPUT	80009	670-3488-15
A4	----- -----			(1482C ONLY)		
A4	670-3488-19	B073322	B073439	CKT BOARD ASSY:SWEEP OUTPUT	80009	670-3488-19
A4	----- -----			(1482C ONLY)		

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A4	670-3488-22	B073440	B073731	CKT BOARD ASSY:SWEEP OUTPUT	80009	670-3488-22
A4	----- -----			(1482C ONLY)		
A4	670-3488-24	B073732	B084040	CKT BOARD ASSY:SWEEP OUTPUT	80009	670-3488-24
A4	----- -----			(1482C ONLY)		
A4	670-3488-30	B084041	B094089	CKT BOARD ASSY:SWEEP OUTPUT	80009	670-3488-30
A4	----- -----			(1482C ONLY)		
A4	670-3488-34	B094090		CKT BOARD ASSY:SWEEP OUTPUT	80009	670-3488-34
A4	----- -----			(1482C ONLY)		
A4	670-3488-05	B060000	B079761	CKT BOARD ASSY:SWEEP OUTPUT	80009	670-3488-05
A4	----- -----			(1482R ONLY)		
A4	670-3488-15	B079762	B080358	CKT BOARD ASSY:SWEEP OUTPUT	80009	670-3488-15
A4	----- -----			(1482R ONLY)		
A4	670-3488-19	B080359	B081430	CKT BOARD ASSY:SWEEP OUTPUT	80009	670-3488-19
A4	----- -----			(1482R ONLY)		
A4	670-3488-22	B081431	B082413	CKT BOARD ASSY:SWEEP OUTPUT	80009	670-3488-22
A4	----- -----			(1482R ONLY)		
A4	670-3488-24	B082414	B093819	CKT BOARD ASSY:SWEEP OUTPUT	80009	670-3488-24
A4	----- -----			(1482R ONLY)		
A4	670-3488-30	B093820	B104064	CKT BOARD ASSY:SWEEP OUTPUT	80009	670-3488-30
A4	----- -----			(1482R ONLY)		
A4	670-3488-34	B104065		CKT BOARD ASSY:SWEEP OUTPUT	80009	670-3488-34
A4	----- -----			(1482R ONLY)		
A4	670-3488-05	B060000	B061354	CKT BOARD ASSY:SWEEP OUTPUT	80009	670-3488-05
A4	----- -----			(1485C ONLY)		
A4	670-3488-15	B061355	B073372	CKT BOARD ASSY:SWEEP OUTPUT	80009	670-3488-15
A4	----- -----			(1485C ONLY)		
A4	670-3488-19	B073373	B073551	CKT BOARD ASSY:SWEEP OUTPUT	80009	670-3488-19
A4	----- -----			(1485C ONLY)		
A4	670-3488-22	B073552	B073731	CKT BOARD ASSY:SWEEP OUTPUT	80009	670-3488-22
A4	----- -----			(1485C ONLY)		
A4	670-3488-24	B073732	B084040	CKT BOARD ASSY:SWEEP OUTPUT	80009	670-3488-24
A4	----- -----			(1485C ONLY)		
A4	670-3488-30	B084041	B094089	CKT BOARD ASSY:SWEEP OUTPUT	80009	670-3488-30
A4	----- -----			(1485C ONLY)		
A4	670-3488-34	B094090		CKT BOARD ASSY:SWEEP OUTPUT	80009	670-3488-34
A4	----- -----			(1485C ONLY)		
A4	670-3488-05	B060000	B079761	CKT BOARD ASSY:SWEEP OUTPUT	80009	670-3488-05
A4	----- -----			(1485R ONLY)		
A4	670-3488-15	B079762	B080413	CKT BOARD ASSY:SWEEP OUTPUT	80009	670-3488-15
A4	----- -----			(1485R ONLY)		
A4	670-3488-19	B080414	B081492	CKT BOARD ASSY:SWEEP OUTPUT	80009	670-3488-19
A4	----- -----			(1485R ONLY)		
A4	670-3488-22	B081493	B082413	CKT BOARD ASSY:SWEEP OUTPUT	80009	670-3488-22
A4	----- -----			(1485R ONLY)		
A4	670-3488-24	B082414	B093819	CKT BOARD ASSY:SWEEP OUTPUT	80009	670-3488-22
A4	----- -----			(1485R ONLY)		
A4	670-3488-30	B093820	B104064	CKT BOARD ASSY:SWEEP OUTPUT	80009	670-3488-30
A4	----- -----			(1485R ONLY)		
A4	670-3488-34	B104065		CKT BOARD ASSY:SWEEP OUTPUT	80009	670-3488-34
A4	----- -----			(1485R ONLY)		
A5	670-3754-00			CKT BOARD ASSY:PIGGY BACK	80009	670-3754-00
A6	670-3487-02	B060000	B061408	CKT BOARD ASSY:SYNC AND TIMING	80009	670-3487-02
A6	----- -----			(1480C ONLY)		

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A6	670-3487-05	B061409	B062196	CKT BOARD ASSY:SYNC AND TIMING	80009	670-3487-05
A6	----- -----			(1480C ONLY)		
A6	670-3487-09	B062197	B073677	CKT BOARD ASSY:SYNC AND TIMING	80009	670-3487-09
A6	----- -----			(1480C ONLY)		
A6	670-3487-11	B073678		CKT BOARD ASSY:SYNC AND TIMING	80009	670-3487-10
A6	----- -----			(1480C ONLY)		
A6	670-3487-02	B060000	B063359	CKT BOARD ASSY:SYNC AND TIMING	80009	670-3487-02
A6	----- -----			(1480R ONLY)		
A6	670-3487-05	B063360	B065929	CKT BOARD ASSY:SYNC AND TIMING	80009	670-3487-05
A6	----- -----			(1480R ONLY)		
A6	670-3487-09	B065930	B082063	CKT BOARD ASSY:SYNC AND TIMING	80009	670-3487-09
A6	----- -----			(1480R ONLY)		
A6	670-3487-11	B082064		CKT BOARD ASSY:SYNC AND TIMING	80009	670-3487-10
A6	----- -----			(1480R ONLY)		
A6	670-3487-02	B060000	B061408	CKT BOARD ASSY:SYNC AND TIMING	80009	670-3487-02
A6	----- -----			(1481C ONLY)		
A6	670-3487-05	B061409	B062196	CKT BOARD ASSY:SYNC AND TIMING	80009	670-3487-05
A6	----- -----			(1481C ONLY)		
A6	670-3487-09	B062197	B073678	CKT BOARD ASSY:SYNC AND TIMING	80009	670-3487-09
A6	----- -----			(1481C ONLY)		
A6	670-3487-11	B073679		CKT BOARD ASSY:SYNC AND TIMING	80009	670-3487-10
A6	----- -----			(1481C ONLY)		
A6	670-3487-02	B060000	B063359	CKT BOARD ASSY:SYNC AND TIMING	80009	670-3487-02
A6	----- -----			(1481R ONLY)		
A6	670-3487-05	B063360	B065929	CKT BOARD ASSY:SYNC AND TIMING	80009	670-3487-05
A6	----- -----			(1481R ONLY)		
A6	670-3487-09	B065930	B082044	CKT BOARD ASSY:SYNC AND TIMING	80009	670-3487-09
A6	----- -----			(1481R ONLY)		
A6	670-3487-11	B082045		CKT BOARD ASSY:SYNC AND TIMING	80009	670-3487-10
A6	----- -----			(1481R ONLY)		
A6	670-3487-02	B060000	B061408	CKT BOARD ASSY:SYNC AND TIMING	80009	670-3487-02
A6	----- -----			(1482C ONLY)		
A6	670-3487-05	B061409	B062196	CKT BOARD ASSY:SYNC AND TIMING	80009	670-3487-05
A6	----- -----			(1482C ONLY)		
A6	670-3487-09	B062197	B073442	CKT BOARD ASSY:SYNC AND TIMING	80009	670-3487-09
A6	----- -----			(1482C ONLY)		
A6	670-3487-11	B073443		CKT BOARD ASSY:SYNC AND TIMING	80009	670-3487-10
A6	----- -----			(1482C ONLY)		
A6	670-3487-02	B060000	B063359	CKT BOARD ASSY:SYNC AND TIMING	80009	670-3487-02
A6	----- -----			(1482R ONLY)		
A6	670-3487-05	B063360	B065929	CKT BOARD ASSY:SYNC AND TIMING	80009	670-3487-05
A6	----- -----			(1482R ONLY)		
A6	670-3487-09	B065930	B082230	CKT BOARD ASSY:SYNC AND TIMING	80009	670-3487-09
A6	----- -----			(1482R ONLY)		
A6	670-3487-11	B082231		CKT BOARD ASSY:SYNC AND TIMING	80009	670-3487-10
A6	----- -----			(1482R ONLY)		
A6	670-3487-02	B060000	B061408	CKT BOARD ASSY:SYNC AND TIMING	80009	670-3487-02
A6	----- -----			(1485C ONLY)		
A6	670-3487-05	B061409	B062196	CKT BOARD ASSY:SYNC AND TIMING	80009	670-3487-05
A6	----- -----			(1485C ONLY)		
A6	670-3487-09	B062197	B073711	CKT BOARD ASSY:SYNC AND TIMING	80009	670-3487-09
A6	----- -----			(1485C ONLY)		
A6	670-3487-11	B073712		CKT BOARD ASSY:SYNC AND TIMING	80009	670-3487-10
A6	----- -----			(1485C ONLY)		

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A6	670-3487-02	B060000	B063359	CKT BOARD ASSY:SYNC AND TIMING	80009	670-3487-02
A6	----- -----			(1485R ONLY)		
A6	670-3487-05	B063360	B065929	CKT BOARD ASSY:SYNC AND TIMING	80009	670-3487-05
A6	----- -----			(1485R ONLY)		
A6	670-3487-09	B065930	B082046	CKT BOARD ASSY:SYNC AND TIMING	80009	670-3487-09
A6	----- -----			(1485R ONLY)		
A6	670-3487-11	B082047		CKT BOARD ASSY:SYNC AND TIMING	80009	670-3487-10
A6	----- -----			(1485R ONLY)		
A6	670-3487-13	B073678		CKT BOARD ASSY:SYNC AND TIMING	80009	670-3487-13
A6	----- -----			(1480C OPTION 07 ONLY)		
A6	670-3487-13	B082064		CKT BOARD ASSY:SYNC AND TIMING	80009	670-3487-13
A6	----- -----			(1480R OPTION 07 ONLY)		
A6	670-3487-13	B073679		CKT BOARD ASSY:SYNC AND TIMING	80009	670-3487-13
A6	----- -----			(1481C OPTION 07 ONLY)		
A6	670-3487-13	B082045		CKT BOARD ASSY:SYNC AND TIMING	80009	670-3487-13
A6	----- -----			(1481R OPTION 07 ONLY)		
A6	670-3487-13	B073443		CKT BOARD ASSY:SYNC AND TIMING	80009	670-3487-13
A6	----- -----			(1482C OPTION 07 ONLY)		
A6	670-3487-13	B082231		CKT BOARD ASSY:SYNC AND TIMING	80009	670-3487-13
A6	----- -----			(1482R OPTION 07 ONLY)		
A6	670-3487-13	B073712		CKT BOARD ASSY:SYNC AND TIMING	80009	670-3487-13
A6	----- -----			(1485C OPTION 07 ONLY)		
A6	670-3487-13	B082047		CKT BOARD ASSY:SYNC AND TIMING	80009	670-3487-13
A6	----- -----			(1485R OPTION 07 ONLY)		
A7	670-3515-00			CKT BOARD ASSY:FRONT PANEL CONNECTOR	80009	670-3515-00
A7A1	670-3915-00			CKT BOARD ASSY:FRONT PANEL CONNECTOR	80009	670-3915-00
A7A1	----- -----			(OPTION 04 & 05 ONLY)		
A8	670-3516-00			CKT BOARD ASSY:FRONT PANEL CONNECTOR	80009	670-3516-00
A9	670-3490-01	B060000	B062399	CKT BOARD ASSY:POWER SUPPLY	80009	670-3490-01
A9	----- -----			(1480C ONLY)		
A9	670-3490-02	B062400	B073291	CKT BOARD ASSY:POWER SUPPLY	80009	670-3490-02
A9	----- -----			(1480C ONLY)		
A9	670-3490-03	B073292	B073458	CKT BOARD ASSY:POWER SUPPLY	80009	670-3490-03
A9	----- -----			(1480C ONLY)		
A9	670-3490-04	B073459	B073693	CKT BOARD ASSY:POWER SUPPLY	80009	670-3490-04
A9	----- -----			(1480C ONLY)		
A9	670-3490-05	B073694	B073779	CKT BOARD ASSY:POWER SUPPLY	80009	670-3490-05
A9	----- -----			(1480C ONLY)		
A9	670-3490-06	B073780		CKT BOARD ASSY:POWER SUPPLY	80009	670-3490-06
A9	----- -----			(1480C ONLY)		
A9	670-3490-01	B060000	B066194	CKT BOARD ASSY:POWER SUPPLY	80009	670-3490-01
A9	----- -----			(1480R ONLY)		
A9	670-3490-02	B066195	B080368	CKT BOARD ASSY:POWER SUPPLY	80009	670-3490-02
A9	----- -----			(1480R ONLY)		
A9	670-3490-03	B080369	B080964	CKT BOARD ASSY:POWER SUPPLY	80009	670-3490-03
A9	----- -----			(1480R ONLY)		
A9	670-3490-04	B080965	B081953	CKT BOARD ASSY:POWER SUPPLY	80009	670-3490-04
A9	----- -----			(1480R ONLY)		
A9	670-3490-05	B081954	B082679	CKT BOARD ASSY:POWER SUPPLY	80009	670-3490-05
A9	----- -----			(1480R ONLY)		
A9	670-3490-06	B082680		CKT BOARD ASSY:POWER SUPPLY	80009	670-3490-06
A9	----- -----			(1480R ONLY)		
A9	670-3490-02	B060000	B073384	CKT BOARD ASSY:POWER SUPPLY	80009	670-3490-02
A9	----- -----			(1481C ONLY)		

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A9	670-3490-03	B073385	B073458	CKT BOARD ASSY:POWER SUPPLY	80009	670-3490-03
A9	----- -----			(1481C ONLY)		
A9	670-3490-04	B073459	B073693	CKT BOARD ASSY:POWER SUPPLY	80009	670-3490-04
A9	----- -----			(1481C ONLY)		
A9	670-3490-05	B073694	B073779	CKT BOARD ASSY:POWER SUPPLY	80009	670-3490-04
A9	----- -----			(1481C ONLY)		
A9	670-3490-06	B073780		CKT BOARD ASSY:POWER SUPPLY	80009	670-3490-06
A9	----- -----			(1481C ONLY)		
A9	670-3490-02	B060000	B080369	CKT BOARD ASSY:POWER SUPPLY	80009	670-3490-02
A9	----- -----			(1481R ONLY)		
A9	670-3490-03	B080370	B080964	CKT BOARD ASSY:POWER SUPPLY	80009	670-3490-03
A9	----- -----			(1481R ONLY)		
A9	670-3490-04	B080965	B081953	CKT BOARD ASSY:POWER SUPPLY	80009	670-3490-04
A9	----- -----			(1481R ONLY)		
A9	670-3490-05	B081954	B082679	CKT BOARD ASSY:POWER SUPPLY	80009	670-3490-05
A9	----- -----			(1481R ONLY)		
A9	670-3490-06	B082680		CKT BOARD ASSY:POWER SUPPLY	80009	670-3490-06
A9	----- -----			(1481R ONLY)		
A9	670-3490-03	B060000	B073458	CKT BOARD ASSY:POWER SUPPLY	80009	670-3490-03
A9	----- -----			(1482C ONLY)		
A9	670-3490-04	B073459	B073693	CKT BOARD ASSY:POWER SUPPLY	80009	670-3490-04
A9	----- -----			(1482C ONLY)		
A9	670-3490-05	B073694	B073779	CKT BOARD ASSY:POWER SUPPLY	80009	670-3490-04
A9	----- -----			(1482C ONLY)		
A9	670-3490-06	B073780		CKT BOARD ASSY:POWER SUPPLY	80009	670-3490-06
A9	----- -----			(1482C ONLY)		
A9	670-3490-02	B060000	B080358	CKT BOARD ASSY:POWER SUPPLY	80009	670-3490-02
A9	----- -----			(1482R ONLY)		
A9	670-3490-03	B080359	B080964	CKT BOARD ASSY:POWER SUPPLY	80009	670-3490-03
A9	----- -----			(1482R ONLY)		
A9	670-3490-04	B080965	B081953	CKT BOARD ASSY:POWER SUPPLY	80009	670-3490-04
A9	----- -----			(1482R ONLY)		
A9	670-3490-05	B081954	B082679	CKT BOARD ASSY:POWER SUPPLY	80009	670-3490-05
A9	----- -----			(1482R ONLY)		
A9	670-3490-06	B082680		CKT BOARD ASSY:POWER SUPPLY	80009	670-3490-06
A9	----- -----			(1482R ONLY)		
A9	670-3490-02	B060000	B073367	CKT BOARD ASSY:POWER SUPPLY	80009	670-3490-02
A9	----- -----			(1485C ONLY)		
A9	670-3490-03	B073368	B073458	CKT BOARD ASSY:POWER SUPPLY	80009	670-3490-03
A9	----- -----			(1485C ONLY)		
A9	670-3490-04	B073459	B073693	CKT BOARD ASSY:POWER SUPPLY	80009	670-3490-04
A9	----- -----			(1485C ONLY)		
A9	670-3490-05	B073694	B073779	CKT BOARD ASSY:POWER SUPPLY	80009	670-3490-05
A9	----- -----			(1485C ONLY)		
A9	670-3490-06	B073780		CKT BOARD ASSY:POWER SUPPLY	80009	670-3490-05
A9	----- -----			(1485C ONLY)		
A9	670-3490-02	B060000	B080377	CKT BOARD ASSY:POWER SUPPLY	80009	670-3490-02
A9	----- -----			(1485R ONLY)		
A9	670-3490-03	B080378	B080964	CKT BOARD ASSY:POWER SUPPLY	80009	670-3490-03
A9	----- -----			(1485R ONLY)		
A9	670-3490-04	B080965	B081953	CKT BOARD ASSY:POWER SUPPLY	80009	670-3490-04
A9	----- -----			(1485R ONLY)		

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A9	670-3490-05	B081954	B082679	CKT BOARD ASSY:POWER SUPPLY	80009	670-3490-05
A9	----- -----			(1485R ONLY)		
A9	670-3490-06	B082680		CKT BOARD ASSY:POWER SUPPLY	80009	670-3490-06
A9	----- -----			(1485R ONLY)		
A11	670-4387-00			CKT BOARD ASSY:RGB	80009	670-4387-00
A13	670-4327-02			CKT BOARD ASSY:SLOW SWEEP	80009	670-4327-02
A13	----- -----			(OPTION 07 ONLY)		
A14	670-4011-00			CKT BOARD ASSY:CRT SCALE LIGHT	80009	670-4011-00
A15	670-3915-00			CKT BOARD ASSY:FRONT PANEL CONNECTOR	80009	670-3915-00
A15	----- -----			(OPTION 04 ONLY)		

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
C1002	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	59821	SDDH69J203Z
C1023	281-0077-00			CAP.,VAR,AIR DI:1.3-5.4PF,350V	74970	189-0502-075
C1024	290-0367-00			CAP.,FXD,ELCTLT:70UF,20%,6V NONPOLARIZED	56289	30D1802
C1034	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	59660	831610Y5U0102P
C1038	283-0081-00			CAP.,FXD,CER DI:0.1UF,+80-20%,25V	59821	2DDU69E104Z
C1042	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	59821	SDDH69J203Z
C1043	283-0220-00			CAP.,FXD,CER DI:0.01UF,20%,50V	72982	8121N075X7R0103M
C1044	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	59660	831610Y5U0102P
C1046	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	59660	831610Y5U0102P
C1048	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	59660	831610Y5U0102P
C1053	281-0500-00			CAP.,FXD,CER DI:2.2PF,+/-0.5PF,500V	59660	0301-080-C0J0
C1055	283-0620-00	B060000	B079999	CAP.,FXD,MICA D:470PF,1%,300V	T0891	RDM15FD471F03
C1055	----- -----			(1480C ONLY)		
C1055	283-0639-00	B080000		CAP.,FXD,MICA D:56PF,1%,100V	00853	D151E560F0
C1055	----- -----			(1480C ONLY)		
C1055	283-0620-00	B060000	B089999	CAP.,FXD,MICA D:470PF,1%,300V	T0891	RDM15FD471F03
C1055	----- -----			(1480R ONLY)		
C1055	283-0639-00	B090000		CAP.,FXD,MICA D:56PF,1%,100V	00853	D151E560F0
C1055	----- -----			(1480R ONLY)		
C1056	281-0077-00			CAP.,VAR,AIR DI:1.3-5.4PF,350V	74970	189-0502-075
C1057	290-0367-00			CAP.,FXD,ELCTLT:70UF,20%,6V NONPOLARIZED	56289	30D1802
C1073	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	59821	SDDH69J203Z
C1080	281-0205-00			CAP.,VAR,PLSTC:5.5-65PF,100V	80031	2810C5R565QJ02F0
C1081	283-0660-00			CAP.,FXD,MICA D:510PF,2%,500V	00853	D155F511G0
C1082	283-0648-00			CAP.,FXD,MICA D:10PF,5%,100V	00853	D151C100D0
C1091	283-0638-00			CAP.,FXD,MICA D:130PF,1%,100V	00853	D151F131F0
C1105	290-0517-00			CAP.,FXD,ELCTLT:6.8UF,20%,35V	90201	TDC685M035FL
C1107	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	59660	831610Y5U0102P
C1108	290-0523-00			CAP.,FXD,ELCTLT:2.2UF,20%,20V	56289	196D225X0020HA1
C1109	283-0220-00			CAP.,FXD,CER DI:0.01UF,20%,50V	72982	8121N075X7R0103M
C1111	283-0059-00	B073694		CAP.,FXD,CER DI:1UF,+80-20%,50V	96733	ADVIXE
C1111	----- -----			(1480C ONLY)		
C1111	283-0059-00	B081954		CAP.,FXD,CER DI:1UF,+80-20%,50V	96733	ADVIXE
C1111	----- -----			(1480R ONLY)		
C1115	283-0220-00			CAP.,FXD,CER DI:0.01UF,20%,50V	72982	8121N075X7R0103M
C1124	283-0220-00			CAP.,FXD,CER DI:0.01UF,20%,50V	72982	8121N075X7R0103M
C1154	290-0523-00			CAP.,FXD,ELCTLT:2.2UF,20%,20V	56289	196D225X0020HA1
C1156	290-0517-00			CAP.,FXD,ELCTLT:6.8UF,20%,35V	90201	TDC685M035FL
C1162	290-0523-00			CAP.,FXD,ELCTLT:2.2UF,20%,20V	56289	196D225X0020HA1
C1166	290-0523-00			CAP.,FXD,ELCTLT:2.2UF,20%,20V	56289	196D225X0020HA1
C1171	283-0669-00			CAP.,FXD,MICA D:360PF,1%,500V	00853	D155F361F0
C1181	283-0605-00			CAP.,FXD,MICA D:678PF,1%,300V	00853	D153F6780F0
C1182	281-0205-00			CAP.,VAR,PLSTC:5.5-65PF,100V	80031	2810C5R565QJ02F0
C1183	281-0577-00			CAP.,FXD,CER DI:14PF,5%,500V	59660	301000C0G0140J
C1184	283-0669-00			CAP.,FXD,MICA D:360PF,1%,500V	00853	D155F361F0
C1193	283-0638-00			CAP.,FXD,MICA D:130PF,1%,100V	00853	D151F131F0
C1200	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	59660	831610Y5U0102P
C1232	281-0123-00			CAP.,VAR,CER DI:5-25PF,100V	59660	518-000A5-25
C1235	281-0123-00			CAP.,VAR,CER DI:5-25PF,100V	59660	518-000A5-25
C1237	283-0615-00			CAP.,FXD,MICA D:33PF,5%,500V	00853	D155E330J0
C1237	----- -----			(END USAGE 670-3485-23 1480C/1480R ONLY)		
C1237	283-0663-00			CAP.,FXD,MICA D:16.8PF,+/-0.5PF,500V	00853	D155C16R8D0
C1237	----- -----			(END USAGE 670-3485-29 1480C/1480R ONLY)		

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
C1237	283-0615-00			CAP.,FXD,MICA D:33PF,5%,500V	00853	D155E330J0
C1237	----- -----			(END USAGE (670-3485-34 1480C/1480R ONLY)		
C1237	283-0663-00			CAP.,FXD,MICA D:16.8PF,+/-0.5PF,500V	00853	D155C16R8D0
C1237	----- -----			(BEGIN USAGE (670-3485-39 1480C/1480R ONLY)		
C1237	283-0663-00			CAP.,FXD,MICA D:16.8PF,+/-0.5PF,500V	00853	D155C16R8D0
C1237	----- -----			(END USAGE 670-3485-30 1480C,1482C,1485C		
C1237	----- -----			OPTION 04 ONLY)		
C1237	283-0615-00			CAP.,FXD,MICA D:33PF,5%,500V	00853	D155E330J0
C1237	----- -----			(END USAGE 670-3485-35 1480C,1482C,1485C		
C1237	----- -----			OPTION 04 ONLY)		
C1237	283-0663-00			CAP.,FXD,MICA D:16.8PF,+/-0.5PF,500V	00853	D155C16R8D0
C1237	----- -----			(BEGIN USAGE 670-3485-40 1480C,1482C,1485C		
C1237	----- -----			OPTION 04 ONLY)		
C1237	283-0663-00			CAP.,FXD,MICA D:16.8PF,+/-0.5PF,500V	00853	D155C16R8D0
C1237	----- -----			(END USAGE 670-3485-33 1481C,1485C		
C1237	----- -----			OPTION 04 ONLY)		
C1237	283-0615-00			CAP.,FXD,MICA D:33PF,5%,500V	00853	D155E330J0
C1237	----- -----			(END USAGE 670-3485-38 1481C,1485C		
C1237	----- -----			OPTION 04 ONLY)		
C1237	283-0663-00			CAP.,FXD,MICA D:16.8PF,+/-0.5PF,500V	00853	D155C16R8D0
C1237	----- -----			(BEGIN USAGE 670-3485-43 1481C,1485C		
C1237	----- -----			OPTION 04 ONLY)		
C1237	283-0663-00			CAP.,FXD,MICA D:16.8PF,+/-0.5PF,500V	00853	D155C16R8D0
C1237	----- -----			(END USAGE 670-3485-32 1481C/1481R,1482C		
C1237	----- -----			/1482R,1485C/1485R ONLY)		
C1237	283-0615-00			CAP.,FXD,MICA D:33PF,5%,500V	00853	D155E330J0
C1237	----- -----			(END USAGE 670-3485-37 1481C/1481R,1482C		
C1237	----- -----			/1482R,1485C/1485R ONLY)		
C1237	283-0663-00			CAP.,FXD,MICA D:16.8PF,+/-0.5PF,500V	00853	D155C16R8D0
C1237	----- -----			(BEGIN USAGE 670-3485-42 1481C/1481R,1482C		
C1237	----- -----			/1482R,1485C/1485R ONLY)		
C1237	283-0663-00			CAP.,FXD,MICA D:16.8PF,+/-0.5PF,500V	00853	D155C16R8D0
C1237	----- -----			(END USAGE 670-3485-33 1481C,1485C		
C1237	----- -----			OPTION 04 ONLY)		
C1237	283-0615-00			CAP.,FXD,MICA D:33PF,5%,500V	00853	D155E330J0
C1237	----- -----			(BEGIN USAGE 670-3485-38 1481C,1485C		
C1237	----- -----			OPTION 04 ONLY)		
C1240	281-0093-00			CAP.,VAR,CER DI:5.5-18PF,350V	59660	538-011A5.5-18
C1244	281-0092-00			CAP.,VAR,CER DI:9-35PF,200V	59660	538-011 D9-35
C1245	283-0642-00			CAP.,FXD,MICA D:33PF,+/-0.5PF,300V	00853	D10-5E330G
C1246	281-0503-00			CAP.,FXD,CER DI:8PF,+/-0.5PF,500V	59660	301-000-C0H0809D
C1252	283-0059-00			CAP.,FXD,CER DI:1UF,+80-20%,50V	96733	ADVIXE
C1261	283-0059-00			CAP.,FXD,CER DI:1UF,+80-20%,50V	96733	ADVIXE
C1272	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	59660	831610Y5U0102P
C1274	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	59660	831610Y5U0102P
C1282	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	59660	831610Y5U0102P
C1283	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	59660	831610Y5U0102P
C1284	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	59660	831610Y5U0102P
C1288	283-0698-00			CAP.,FXD,MICA D:390PF,1%,500V	09023	CD15FD391F03
C1292	283-0646-00			CAP.,FXD,MICA D:170PF,1%,100V	00853	D155F171F0
C1294	283-0636-00			CAP.,FXD,MICA D:36PF,1.4%,100V	00853	D155E360G0
C1295	283-0634-00			CAP.,FXD,MICA D:65PF,1%,100V	00853	D155E650F0
C1331	283-0770-00	B080000		CAP.,FXD,MICA D:300PF,1%,500V	00853	D15-5F301F0
C1331	----- -----			(1480C ONLY)		

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
C1331	283-0770-00	B090000		CAP.,FXD,MICA D:300PF,1%,500V	00853	D15-5F301F0
C1331	----- -----			(1480R ONLY)		
C1338	283-0220-00			CAP.,FXD,CER DI:0.01UF,20%,50V	72982	8121N075X7R0103M
C1339	283-0028-00	B080000		CAP.,FXD,CER DI:0.0022UF,20%,50V	59660	0805585Y5SO222M
C1339	----- -----			(1480C ONLY)		
C1339	283-0028-00	B090000		CAP.,FXD,CER DI:0.0022UF,20%,50V	59660	0805585Y5SO222M
C1339	----- -----			(1480R ONLY)		
C1371	283-0687-00			CAP.,FXD,MICA D:560PF,2%,300V	00853	D153F561G0
C1375	283-0698-00			CAP.,FXD,MICA D:390PF,1%,500V	09023	CD15FD391F03
C1377	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	59821	D103Z40Z5UJDCEX
C1381	283-0626-00			CAP.,FXD,MICA D:1800PF,5%,500V	00853	D195F182J0
C1383	283-0598-00			CAP.,FXD,MICA D:253PF,5%,300V	09023	CD15FD(253)J03
C1387	283-0596-00			CAP.,FXD,MICA D:528PF,1%,300V	00853	D153F5280F0
C1391	283-0649-00			CAP.,FXD,MICA D:105PF,1%,300V	00853	D155F1050F0
C1403	281-0509-00			CAP.,FXD,CER DI:15PF,+/-1.5PF,500V	59660	301-000-C0G0150K
C1407	283-0059-00			CAP.,FXD,CER DI:1UF,+80-20%,50V	96733	ADVIXE
C1413	281-0500-00			CAP.,FXD,CER DI:2.2PF,+/-0.5PF,500V	59660	0301-080-C0J0
C1437	281-0091-00			CAP.,VAR,CER DI:2-8PF,350V	59660	538-011 A2-8
C1437	----- -----			(END USAGE 670-3485-34 1480C/1480R ONLY)		
C1437	281-0153-00			CAP.,VAR,AIR DI:1.7-10PF,250V	74970	187-0106-005
C1437	----- -----			(BEGIN USAGE 670-3485-39 1480C/1480R ONLY)		
C1437	281-0091-00			CAP.,VAR,CER DI:2-8PF,350V	59660	538-011 A2-8
C1437	----- -----			(END USAGE 670-3485-37 1481C/1481R		
C1437	----- -----			.1482C/1482R,1485C/1485R ONLY)		
C1437	281-0153-00			CAP.,VAR,AIR DI:1.7-10PF,250V	74970	187-0106-005
C1437	----- -----			(BEGIN USAGE 670-3485-42 1481C/R,1482C/R		
C1437	----- -----			.1485C/R ONLY)		
C1437	281-0091-00			CAP.,VAR,CER DI:2-8PF,350V	59660	538-011 A2-8
C1437	----- -----			(END USAGE 670-3485-35 1480C,1482C		
C1437	----- -----			,1485C OPTION 04 ONLY)		
C1437	281-0153-00			CAP.,VAR,AIR DI:1.7-10PF,250V	74970	187-0106-005
C1437	----- -----			(BEGIN USAGE 670-3485-40 1480C,1482C		
C1437	----- -----			,1485C OPTION 04 ONLY)		
C1437	281-0091-00	B060000	B094089	CAP.,VAR,CER DI:2-8PF,350V	59660	538-011 A2-8
C1437	----- -----			(END USAGE 670-3485-38 1481C,1485C		
C1437	----- -----			OPTION 04 ONLY)		
C1437	281-0153-00	B094090		CAP.,VAR,AIR DI:1.7-10PF,250V	74970	187-0106-005
C1437	----- -----			(END USAGE 670-3485-43 1481C,1485C		
C1437	----- -----			OPTION 04 ONLY)		
C1445	283-0620-00	B060000	B079999	CAP.,FXD,MICA D:470PF,1%,300V	T0891	RDM15FD471F03
C1445	----- -----			(1480C ONLY)		
C1445	283-0639-00	B080000		CAP.,FXD,MICA D:56PF,1%,100V	00853	D151E560F0
C1445	----- -----			(1480C ONLY)		
C1445	283-0620-00	B060000	B089999	CAP.,FXD,MICA D:470PF,1%,300V	T0891	RDM15FD471F03
C1445	----- -----			(1480R ONLY)		
C1445	283-0639-00	B090000		CAP.,FXD,MICA D:56PF,1%,100V	00853	D151E560F0
C1445	----- -----			(1480R ONLY)		
C1447	283-0081-00			CAP.,FXD,CER DI:0.1UF,+80-20%,25V	59821	2DDU69E104Z
C1451	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	59660	831610Y5U0102P
C1457	290-0517-00			CAP.,FXD,ELCTLT:6.8UF,20%,35V	90201	TDC685M035FL
C1461	283-0620-00			CAP.,FXD,MICA D:470PF,1%,300V	T0891	RDM15FD471F03
C1485	283-0649-00			CAP.,FXD,MICA D:105PF,1%,300V	00853	D155F1050F0
C1492	290-0517-00			CAP.,FXD,ELCTLT:6.8UF,20%,35V	90201	TDC685M035FL
C1493	281-0509-00			CAP.,FXD,CER DI:15PF,+/-1.5PF,500V	59660	301-000-C0G0150K

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C1507	281-0630-00			CAP.,FXD,CER DI:390PF,5%,500V	72982	630000Y5D391J
C1511	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	59821	D103Z40Z5UJDCEX
C1519	281-0503-00			CAP.,FXD,CER DI:8PF,+/-0.5PF,500V	59660	301-000-C0H0809D
C1535	283-0220-00			CAP.,FXD,CER DI:0.01UF,20%,50V	72982	8121N075X7R0103M
C1541	283-0649-00			CAP.,FXD,MICA D:105PF,1%,300V	00853	D155F1050F0
C1567	281-0091-00			CAP.,VAR,CER DI:2-8PF,350V	59660	538-011 A2-8
C1567	----- -----			(END USAGE 670-3485-34 1480C/1480R ONLY)		
C1567	281-0153-00			CAP.,VAR,AIR DI:1.7-10PF,250V	74970	187-0106-005
C1567	----- -----			(BEGIN USAGE 670-3485-39 1480C/1480R ONLY)		
C1567	281-0091-00			CAP.,VAR,CER DI:2-8PF,350V	59660	538-011 A2-8
C1567	----- -----			(END USAGE 670-3485-37 1481C/1481R		
C1567	----- -----			.1482C/1482R,1485C/1485R ONLY)		
C1567	281-0153-00			CAP.,VAR,AIR DI:1.7-10PF,250V	74970	187-0106-005
C1567	----- -----			(BEGIN USAGE 670-3485-42 1481C/R,1482C/R		
C1567	----- -----			.1485C/R ONLY)		
C1567	281-0091-00			CAP.,VAR,CER DI:2-8PF,350V	59660	538-011 A2-8
C1567	----- -----			(END USAGE 670-3485-35 1480C,1482C		
C1567	----- -----			,1485C OPTION 04 ONLY)		
C1567	281-0153-00			CAP.,VAR,AIR DI:1.7-10PF,250V	74970	187-0106-005
C1567	----- -----			(BEGIN USAGE 670-3485-40 1480C,1482C		
C1567	----- -----			,1485C OPTION 04 ONLY)		
C1572	290-0517-00			CAP.,FXD,ELCTLT:6.8UF,20%,35V	90201	TDC685M035FL
C1578	290-0745-00			CAP.,FXD,ELCTLT:22UF,+50-10%,25V	54473	ECE-A25V22L
C1579	290-0804-00			CAP.,FXD,ELCTLT:10UF,+50-10%,25V	55680	ULA1E100TEA
C1579	290-0804-00	B080000		CAP.,FXD,ELCTLT:10UF,+50-10%,25V	55680	ULA1E100TEA
C1579	----- -----			(1480C ONLY)		
C1579	281-0804-00	B090000		CAP.,FXD,CER DI:10PF,0.5%,400V		
C1579	----- -----			(1480R ONLY)		
C1590	283-0111-00	B080000		CAP.,FXD,CER DI:0.1UF,20%,50V	96733	ADVISE
C1590	----- -----			(1480C ONLY)		
C1590	283-0111-00	B090000		CAP.,FXD,CER DI:0.1UF,20%,50V	96733	ADVISE
C1590	----- -----			(1480R ONLY)		
C1593	281-0662-00			CAP.,FXD,CER DI:10PF,+/-0.5PF,500V	59660	301-000H3M0100D
C1611	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	59821	D103Z40Z5UJDCEX
C1626	283-0620-00			CAP.,FXD,MICA D:470PF,1%,300V	T0891	RDM15FD471F03
C1666	281-0204-00	B060000	B079999	CAP.,VAR,PLSTC:2-22PF,100V	80031	2807C00222MJ02
C1666	----- -----			(1480C ONLY)		
C1666	281-0204-00	B060000	B089999	CAP.,VAR,PLSTC:2-22PF,100V	80031	2807C00222MJ02
C1666	----- -----			(1480R ONLY)		
C1670	281-0642-00	B060000	B079999	CAP.,FXD,CER DI:24PF,10%,500V		
C1670	----- -----			(1480C ONLY)		
C1670	281-0642-00	B060000	B089999	CAP.,FXD,CER DI:24PF,10%,500V		
C1670	----- -----			(1480R ONLY)		
C1680	283-0059-00			CAP.,FXD,CER DI:1UF,+80-20%,50V	96733	ADVIXE
C1687	290-0517-00			CAP.,FXD,ELCTLT:6.8UF,20%,35V	90201	TDC685M035FL
C1688	283-0632-00			CAP.,FXD,MICA D:87PF,1%,100V	00853	D155E870F0
C1699	283-0081-00			CAP.,FXD,CER DI:0.1UF,+80-20%,25V	59821	2DDU69E104Z
C1712	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	59660	831610Y5U0102P
C1727	283-0639-00	B080000		CAP.,FXD,MICA D:56PF,1%,100V	00853	D151E560F0
C1727	----- -----			(1480C ONLY)		
C1727	283-0639-00	B090000		CAP.,FXD,MICA D:56PF,1%,100V	00853	D151E560F0
C1727	----- -----			(1480R ONLY)		
C1775	290-0517-00			CAP.,FXD,ELCTLT:6.8UF,20%,35V	90201	TDC685M035FL
C1788	283-0649-00			CAP.,FXD,MICA D:105PF,1%,300V	00853	D155F1050F0

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
C1791	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	59660	831610Y5U0102P
C1815	283-0268-00	B080000		CAP.,FXD,CER DI:0.015UF,10%,50V	56289	1C20X7R153K050B
C1815	----- -----			(OPTION 04 CABINET ONLY)		
C1815	283-0268-00	B090000		CAP.,FXD,CER DI:0.015UF,10%,50V	56289	1C20X7R153K050B
C1815	----- -----			(OPTION 04 RACKMOUNT ONLY)		
C1819	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	59821	D103Z40Z5UJDCEX
C1820	283-0111-00	B080000		CAP.,FXD,CER DI:0.1UF,20%,50V	96733	ADVISE
C1820	----- -----			(OPTION 04 CABINET ONLY)		
C1820	283-0111-00	B090000		CAP.,FXD,CER DI:0.1UF,20%,50V	96733	ADVISE
C1820	----- -----			(OPTION 04 RACKMOUNT ONLY)		
C1835	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	59660	831610Y5U0102P
C1854	281-0205-00			CAP.,VAR,PLSTC:5.5-65PF,100V	80031	2810C5R565QJ02F0
C1858	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	59660	831610Y5U0102P
C1862	281-0204-00			CAP.,VAR,PLSTC:2-22PF,100V	80031	2807C00222MJ02
C1877	290-0517-00	B060000	B079999	CAP.,FXD,ELCTLT:6.8UF,20%,35V	90201	TDC685M035FL
C1877	----- -----			(1480C ONLY)		
C1877	290-0517-00	B060000	B089999	CAP.,FXD,ELCTLT:6.8UF,20%,35V	90201	TDC685M035FL
C1877	----- -----			(1480R ONLY)		
C1879	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	59660	831610Y5U0102P
C1885	290-0517-00			CAP.,FXD,ELCTLT:6.8UF,20%,35V	90201	TDC685M035FL
C1886	290-0517-00	B060000	B079999	CAP.,FXD,ELCTLT:6.8UF,20%,35V	90201	TDC685M035FL
C1886	----- -----			(1480C ONLY)		
C1886	283-0065-00	B080000		CAP.,FXD,CER DI:0.001UF,5%,100V	59660	0835-591Y5EO102J
C1886	----- -----			(1480C ONLY)		
C1886	290-0517-00	B060000	B089999	CAP.,FXD,ELCTLT:6.8UF,20%,35V	90201	TDC685M035FL
C1886	----- -----			(1480R ONLY)		
C1886	283-0065-00	B090000		CAP.,FXD,CER DI:0.001UF,5%,100V	59660	0835-591Y5EO102J
C1886	----- -----			(1480R ONLY)		
C1888	283-0594-00			CAP.,FXD,MICA D:0.001UF,1%,100V	00853	D151F102F0
C1892	283-0024-00			CAP.,FXD,CER DI:0.1UF,+80-20%,50V	31433	C322C104M5R5CA
C1923	290-0746-00			CAP.,FXD,ELCTLT:47UF,+50-10%,16V	55680	ULA1C470TEA
C1931	290-0746-00			CAP.,FXD,ELCTLT:47UF,+50-10%,16V	55680	ULA1C470TEA
C1954	281-0511-00	B060000	B079999	CAP.,FXD,CER DI:22PF,+/-2.2PF,500V	59660	301-000C0G0220K
C1954	----- -----			(1480C ONLY)		
C1954	283-0642-00	B080000		CAP.,FXD,MICA D:33PF,+/-0.5PF,300V	00853	D10-5E330G
C1954	----- -----			(1480C ONLY)		
C1954	281-0511-00	B060000	B089999	CAP.,FXD,CER DI:22PF,+/-2.2PF,500V	59660	301-000C0G0220K
C1954	----- -----			(1480R ONLY)		
C1954	283-0642-00	B090000		CAP.,FXD,MICA D:33PF,+/-0.5PF,300V	00853	D10-5E330G
C1954	----- -----			(1480R ONLY)		
C1965	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	59660	831610Y5U0102P
C2228	281-0209-00			CAP.,VAR,AIR DI:1.3-5.4PF,250V	74970	187-0303-105
C2228	----- -----			(OPTION 01 ONLY)		
C2238	285-0898-00			CAP.,FXD,PLSTC:0.47UF,10%,100V	56289	LP66A1B474K
C2238	----- -----			(OPTION 01 ONLY)		
C2241	290-0517-00			CAP.,FXD,ELCTLT:6.8UF,20%,35V	90201	TDC685M035FL
C2241	----- -----			(OPTION 01 ONLY)		
C2243	283-0024-00			CAP.,FXD,CER DI:0.1UF,+80-20%,50V	31433	C322C104M5R5CA
C2243	----- -----			(OPTION 01 ONLY)		
C2246	283-0110-00			CAP.,FXD,CER DI:0.005UF,+80-20%,150V	59660	855-547-E-502Z
C2246	----- -----			(OPTION 01 ONLY)		
C2258	290-0519-00			CAP.,FXD,ELCTLT:100UF,20%,20V	90201	TDC107M020WLD
C2258	----- -----			(OPTION 01 ONLY)		

	Tektronix	Serial/Model No.			Mfr	
Ckt No.	Part No.	Eff	Dscont	Name & Description	Code	Mfr Part Number
C2263	283-0594-00	B060000	B093336	CAP.,FXD,MICA D:0.001UF,1%,100V	00853	D151F102F0
C2263	----- -----			(OPTION 01 ONLY)		
C2263	283-0623-00	B093337		CAP.,FXD,MICA D:1200PF,1%,100V	00853	D195F122F0
C2263	----- -----			(OPTION 01 ONLY)		
C2265	281-0205-00			CAP.,VAR,PLSTC:5.5-65PF,100V	80031	2810C5R565QJ02F0
C2265	----- -----			(OPTION 01 ONLY)		
C2273	283-0115-00			CAP.,FXD,CER DI:47PF,5%,200V	59660	805-519-C0G0470J
C2273	----- -----			(OPTION 01 ONLY)		
C3010	283-0059-00			CAP.,FXD,CER DI:1UF,+80-20%,50V	96733	ADVIXE
C3011	290-0534-00			CAP.,FXD,ELCTLT:1UF,20%,35V	56289	196D105X0035HA1
C3021	283-0593-00			CAP.,FXD,MICA D:0.01UF,1%,100V	00853	D301F103F0
C3022	290-0527-00			CAP.,FXD,ELCTLT:15UF,20%,20V	90201	TDC156M020NFL
C3040	290-0746-00			CAP.,FXD,ELCTLT:47UF,+50-10%,16V	55680	ULA1C470TEA
C3050	283-0081-00			CAP.,FXD,CER DI:0.1UF,+80-20%,25V	59821	2DDU69E104Z
C3053	283-0660-00			CAP.,FXD,MICA D:510PF,2%,500V	00853	D155F511G0
C3061	283-0672-00			CAP.,FXD,MICA D:200PF,1%,500V	00853	D155F2010F0
C3070	283-0655-00			CAP.,FXD,MICA D:0.0033UF,1%,500V	00853	D195F332F0
C3087	283-0026-00			CAP.,FXD,CER DI:0.2UF,+80-20%,25V	56289	274C3
C3088	283-0198-00			CAP.,FXD,CER DI:0.22UF,20%,50V	04222	ADVISE
C3100	290-0745-00			CAP.,FXD,ELCTLT:22UF,+50-10%,25V	54473	ECE-A25V22L
C3110	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	59660	831610Y5U0102P
C3112	290-0525-00			CAP.,FXD,ELCTLT:4.7UF,20%,50V	56289	196D475X0050KA1
C3114	290-0525-00			CAP.,FXD,ELCTLT:4.7UF,20%,50V	56289	196D475X0050KA1
C3120	283-0198-00			CAP.,FXD,CER DI:0.22UF,20%,50V	04222	ADVISE
C3121	283-0628-00			CAP.,FXD,MICA D:410PF,1%,500V	00853	D155F411F0
C3130	283-0198-00			CAP.,FXD,CER DI:0.22UF,20%,50V	04222	ADVISE
C3131	283-0641-00			CAP.,FXD,MICA D:180PF,1%,100V	00853	DD155F181F0
C3136	283-0630-00			CAP.,FXD,MICA D:110PF,1%,100V	00853	D155F111F0
C3160	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	59821	SDDH69J203Z
C3177	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	59821	D103Z40Z5UJDCEX
C3180	283-0081-00			CAP.,FXD,CER DI:0.1UF,+80-20%,25V	59821	2DDU69E104Z
C3181	283-0600-00	B060000	B062277	CAP,FXD,MICA DI:43PF,5%,500V	00853	D105E430J0
C3181	----- -----			(1480C ONLY)		
C3181	283-0616-00	B062278		CAP.,FXD,MICA D:75PF,5%,500V	00853	D155E750J0
C3181	----- -----			(1480C ONLY)		
C3181	283-0600-00	B060000	B066245	CAP,FXD,MICA DI:43PF,5%,500V	00853	D105E430J0
C3181	----- -----			(1480R ONLY)		
C3181	283-0616-00	B066246		CAP.,FXD,MICA D:75PF,5%,500V	00853	D155E750J0
C3181	----- -----			(1480R ONLY)		
C3184	283-0594-00			CAP.,FXD,MICA D:0.001UF,1%,100V	00853	D151F102F0
C3190	283-0167-00			CAP.,FXD,CER DI:0.1UF,10%,100V	72982	8131N145X5R0104K
C3200	290-0745-00			CAP.,FXD,ELCTLT:22UF,+50-10%,25V	54473	ECE-A25V22L
C3201	283-0081-00			CAP.,FXD,CER DI:0.1UF,+80-20%,25V	59821	2DDU69E104Z
C3210	290-0517-00			CAP.,FXD,ELCTLT:6.8UF,20%,35V	90201	TDC685M035FL
C3220	283-0026-00			CAP.,FXD,CER DI:0.2UF,+80-20%,25V	56289	274C3
C3230	283-0081-00			CAP.,FXD,CER DI:0.1UF,+80-20%,25V	59821	2DDU69E104Z
C3241	283-0081-00			CAP.,FXD,CER DI:0.1UF,+80-20%,25V	59821	2DDU69E104Z
C3242	281-0577-00	B062197		CAP.,FXD,CER DI:14PF,5%,500V	59660	301000C0G0140J
C3242	----- -----			(1480C ONLY)		
C3242	281-0577-00	B065930		CAP.,FXD,CER DI:14PF,5%,500V	59660	301000C0G0140J
C3242	----- -----			(1480R ONLY)		
C3250	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	59821	D103Z40Z5UJDCEX
C3251	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	59821	D103Z40Z5UJDCEX
C3252	290-0512-00			CAP.,FXD,ELCTLT:22UF,20%,15V	56289	196D226X0015KA1

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C3258	283-0598-00			CAP.,FXD,MICA D:253PF,5%,300V	09023	CD15FD(253)J03
C3259	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	59821	SDDH69J203Z
C3260	290-0534-00			CAP.,FXD,ELCTLT:1UF,20%,35V	56289	196D105X0035HA1
C3261	283-0167-00			CAP.,FXD,CER DI:0.1UF,10%,100V	72982	8131N145X5R0104K
C3265	290-0536-00			CAP.,FXD,ELCTLT:10UF,20%,25V	90201	TDC106M025FL
C3269	283-0081-00			CAP.,FXD,CER DI:0.1UF,+80-20%,25V	59821	2DDU69E104Z
C3281	283-0593-00			CAP.,FXD,MICA D:0.01UF,1%,100V	00853	D301F103F0
C3282	283-0081-00			CAP.,FXD,CER DI:0.1UF,+80-20%,25V	59821	2DDU69E104Z
C3290	290-0527-00			CAP.,FXD,ELCTLT:15UF,20%,20V	90201	TDC156M020NFL
C3310	283-0081-00			CAP.,FXD,CER DI:0.1UF,+80-20%,25V	59821	2DDU69E104Z
C3320	283-0081-00			CAP.,FXD,CER DI:0.1UF,+80-20%,25V	59821	2DDU69E104Z
C3330	283-0059-00			CAP.,FXD,CER DI:1UF,+80-20%,50V	96733	ADVIXE
C3340	281-0651-00	B062897		CAP.,FXD,CER DI:47PF,5%,200V	59660	0374018T2H0 470J
C3340	----- -----			(1480C ONLY)		
C3340	281-0651-00	B065930		CAP.,FXD,CER DI:47PF,5%,200V	59660	0374018T2H0 470J
C3340	----- -----			(1480R ONLY)		
C3341	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	59660	831610Y5U0102P
C3342	283-0634-00			CAP.,FXD,MICA D:65PF,1%,100V	00853	D155E650F0
C3364	283-0081-00			CAP.,FXD,CER DI:0.1UF,+80-20%,25V	59821	2DDU69E104Z
C3371	283-0081-00			CAP.,FXD,CER DI:0.1UF,+80-20%,25V	59821	2DDU69E104Z
C3373	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	59821	D103Z40Z5UJDCEX
C3400	283-0081-00			CAP.,FXD,CER DI:0.1UF,+80-20%,25V	59821	2DDU69E104Z
C3410	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	59821	SDDH69J203Z
C3411	283-0059-00			CAP.,FXD,CER DI:1UF,+80-20%,50V	96733	ADVIXE
C3420	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	59821	SDDH69J203Z
C3430	283-0081-00			CAP.,FXD,CER DI:0.1UF,+80-20%,25V	59821	2DDU69E104Z
C3431	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	59660	831610Y5U0102P
C3451	283-0645-00			CAP.,FXD,MICA D:790PF,1%,100V	00853	D153F791F0
C3460	283-0600-00			CAP,FXD,MICA DI:43PF,5%,500V	00853	D105E430J0
C3462	290-0534-00			CAP.,FXD,ELCTLT:1UF,20%,35V	56289	196D105X0035HA1
C3470	283-0198-00			CAP.,FXD,CER DI:0.22UF,20%,50V	04222	ADVISE
C3480	283-0593-00			CAP.,FXD,MICA D:0.01UF,1%,100V	00853	D301F103F0
C4003	283-0081-00	B060000	B073580	CAP.,FXD,CER DI:0.1UF,+80-20%,25V	59821	2DDU69E104Z
C4003	----- -----			(1480C ONLY)		
C4003	283-0024-00	B073581		CAP.,FXD,CER DI:0.1UF,+80-20%,50V	31433	C322C104M5R5CA
C4003	----- -----			(1480C ONLY)		
C4003	283-0081-00	B060000	B081486	CAP.,FXD,CER DI:0.1UF,+80-20%,25V	59821	2DDU69E104Z
C4003	----- -----			(1480R ONLY)		
C4003	283-0024-00	B081487		CAP.,FXD,CER DI:0.1UF,+80-20%,50V	31433	C322C104M5R5CA
C4003	----- -----			(1480R ONLY)		
C4003	283-0081-00	B060000	B073579	CAP.,FXD,CER DI:0.1UF,+80-20%,25V	59821	2DDU69E104Z
C4003	----- -----			(1481C ONLY)		
C4003	283-0024-00	B073580		CAP.,FXD,CER DI:0.1UF,+80-20%,50V	31433	C322C104M5R5CA
C4003	----- -----			(1481C ONLY)		
C4003	283-0081-00	B060000	B081484	CAP.,FXD,CER DI:0.1UF,+80-20%,25V	59821	2DDU69E104Z
C4003	----- -----			(1481R ONLY)		
C4003	283-0024-00	B081485		CAP.,FXD,CER DI:0.1UF,+80-20%,50V	31433	C322C104M5R5CA
C4003	----- -----			(1481R ONLY)		
C4003	283-0081-00	B060000	B073439	CAP.,FXD,CER DI:0.1UF,+80-20%,25V	59821	2DDU69E104Z
C4003	----- -----			(1482C ONLY)		
C4003	283-0024-00	B073440		CAP.,FXD,CER DI:0.1UF,+80-20%,50V	31433	C322C104M5R5CA
C4003	----- -----			(1482C ONLY)		

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C4003	283-0081-00	B060000	B081430	CAP.,FXD,CER DI:0.1UF,+80-20%,25V	59821	2DDU69E104Z
C4003	----- -----			(1482R ONLY)		
C4003	283-0024-00	B081431		CAP.,FXD,CER DI:0.1UF,+80-20%,50V	31433	C322C104M5R5CA
C4003	----- -----			(1482R ONLY)		
C4003	283-0081-00	B060000	B073551	CAP.,FXD,CER DI:0.1UF,+80-20%,25V	59821	2DDU69E104Z
C4003	----- -----			(1485C ONLY)		
C4003	283-0024-00	B073552		CAP.,FXD,CER DI:0.1UF,+80-20%,50V	31433	C322C104M5R5CA
C4003	----- -----			(1485C ONLY)		
C4003	283-0081-00	B060000	B081492	CAP.,FXD,CER DI:0.1UF,+80-20%,25V	59821	2DDU69E104Z
C4003	----- -----			(1485R ONLY)		
C4003	283-0024-00	B081493		CAP.,FXD,CER DI:0.1UF,+80-20%,50V	31433	C322C104M5R5CA
C4003	----- -----			(1485R ONLY)		
C4005	283-0081-00	B060000	B073580	CAP.,FXD,CER DI:0.1UF,+80-20%,25V	59821	2DDU69E104Z
C4005	----- -----			(1480C ONLY)		
C4005	283-0024-00	B073581		CAP.,FXD,CER DI:0.1UF,+80-20%,50V	31433	C322C104M5R5CA
C4005	----- -----			(1480C ONLY)		
C4005	283-0081-00	B060000	B081486	CAP.,FXD,CER DI:0.1UF,+80-20%,25V	59821	2DDU69E104Z
C4005	----- -----			(1480R ONLY)		
C4005	283-0024-00	B081487		CAP.,FXD,CER DI:0.1UF,+80-20%,50V	31433	C322C104M5R5CA
C4005	----- -----			(1480R ONLY)		
C4005	283-0081-00	B060000	B073579	CAP.,FXD,CER DI:0.1UF,+80-20%,25V	59821	2DDU69E104Z
C4005	----- -----			(1481C ONLY)		
C4005	283-0024-00	B073580		CAP.,FXD,CER DI:0.1UF,+80-20%,50V	31433	C322C104M5R5CA
C4005	----- -----			(1481C ONLY)		
C4005	283-0081-00	B060000	B081484	CAP.,FXD,CER DI:0.1UF,+80-20%,25V	59821	2DDU69E104Z
C4005	----- -----			(1481R ONLY)		
C4005	283-0024-00	B081485		CAP.,FXD,CER DI:0.1UF,+80-20%,50V	31433	C322C104M5R5CA
C4005	----- -----			(1481R ONLY)		
C4005	283-0081-00	B060000	B073439	CAP.,FXD,CER DI:0.1UF,+80-20%,25V	59821	2DDU69E104Z
C4005	----- -----			(1482C ONLY)		
C4005	283-0024-00	B073440		CAP.,FXD,CER DI:0.1UF,+80-20%,50V	31433	C322C104M5R5CA
C4005	----- -----			(1482C ONLY)		
C4005	283-0081-00	B060000	B081430	CAP.,FXD,CER DI:0.1UF,+80-20%,25V	59821	2DDU69E104Z
C4005	----- -----			(1482R ONLY)		
C4005	283-0024-00	B081431		CAP.,FXD,CER DI:0.1UF,+80-20%,50V	31433	C322C104M5R5CA
C4005	----- -----			(1482R ONLY)		
C4005	283-0081-00	B060000	B073551	CAP.,FXD,CER DI:0.1UF,+80-20%,25V	59821	2DDU69E104Z
C4005	----- -----			(1485C ONLY)		
C4005	283-0024-00	B073552		CAP.,FXD,CER DI:0.1UF,+80-20%,50V	31433	C322C104M5R5CA
C4005	----- -----			(1485C ONLY)		
C4005	283-0081-00	B060000	B081492	CAP.,FXD,CER DI:0.1UF,+80-20%,25V	59821	2DDU69E104Z
C4005	----- -----			(1485R ONLY)		
C4005	283-0024-00	B081493		CAP.,FXD,CER DI:0.1UF,+80-20%,50V	31433	C322C104M5R5CA
C4005	----- -----			(1485R ONLY)		
C4010	290-0517-00			CAP.,FXD,ELCTLT:6.8UF,20%,35V	90201	TDC685M035FL
C4022	283-0081-00			CAP.,FXD,CER DI:0.1UF,+80-20%,25V	59821	2DDU69E104Z
C4055	281-0604-00			CAP.,FXD,CER DI:2.2PF,+/-0.25PF,500V	04222	7001-C0J-2R2C
C4060	281-0091-00			CAP.,VAR,CER DI:2-8PF,350V	59660	538-011 A2-8
C4100	283-0059-00			CAP.,FXD,CER DI:1UF,+80-20%,50V	96733	ADVIXE
C4122	281-0544-00			CAP.,FXD,CER DI:5.6PF,10%,500V	59660	301000C0H0569D
C4150	281-0534-00			CAP.,FXD,CER DI:3.3PF,+/-0.25PF,500V	04222	7001-COJ-3R3C
C4151	281-0503-00			CAP.,FXD,CER DI:8PF,+/-0.5PF,500V	59660	301-000-C0H0809D
C4152	281-0557-00			CAP.,FXD,CER DI:1.8PF,10%,500V	04222	7001-COK-1R8B
C4160	290-0745-00			CAP.,FXD,ELCTLT:22UF,+50-10%,25V	54473	ECE-A25V22L

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C4170	283-0596-00			CAP.,FXD,MICA D:528PF,1%,300V	00853	D153F5280F0
C4190	283-0598-00			CAP.,FXD,MICA D:253PF,5%,300V	09023	CD15FD(253)J03
C4200	290-0745-00			CAP.,FXD,ELCTLT:22UF,+50-10%,25V	54473	ECE-A25V22L
C4201	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	59660	831610Y5U0102P
C4202	283-0059-00			CAP.,FXD,CER DI:1UF,+80-20%,50V	96733	ADVIXE
C4210	281-0544-00			CAP.,FXD,CER DI:5.6PF,10%,500V	59660	301000C0H0569D
C4236	283-0057-00			CAP.,FXD,CER DI:0.1UF,+80-20%,200V	56289	2C20Z5U104Z200B
C4243	281-0529-00			CAP.,FXD,CER DI:1.5PF,+/-0.25PF,500V	04222	7001-COK1R5C
C4250	281-0503-00			CAP.,FXD,CER DI:8PF,+/-0.5PF,500V	59660	301-000-C0H0809D
C4270	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	59660	831610Y5U0102P
C4340	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	59821	D103Z40Z5UJDCEX
C4341	285-0597-00			CAP.,FXD,PLSTC:0.001UF,1%,100V	14752	41OB1B102F
C4342	283-0059-00			CAP.,FXD,CER DI:1UF,+80-20%,50V	96733	ADVIXE
C4370	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	59660	831610Y5U0102P
C4390	283-0641-00			CAP.,FXD,MICA D:180PF,1%,100V	00853	DD155F181F0
C4410	283-0081-00			CAP.,FXD,CER DI:0.1UF,+80-20%,25V	59821	2DDU69E104Z
C4431	283-0059-00			CAP.,FXD,CER DI:1UF,+80-20%,50V	96733	ADVIXE
C4440	281-0510-00			CAP.,FXD,CER DI:22PF,+/-4.4PF,500V	59660	301-000C0G0220M
C4441	281-0549-00			CAP.,FXD,CER DI:68PF,10%,500V	59660	301-000U2J0680K
C4442	290-0746-00			CAP.,FXD,ELCTLT:47UF,+50-10%,16V	55680	ULA1C470TEA
C4450	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	59660	831610Y5U0102P
C4460	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	59660	831610Y5U0102P
C4470	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	59660	831610Y5U0102P
C4471	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	59660	831610Y5U0102P
C4480	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	59660	831610Y5U0102P
C4481	283-0114-00			CAP.,FXD,CER DI:0.0015UF,5%,200V	59660	805534Y5DO152J
C4500	283-0104-00			CAP.,FXD,CER DI:2000PF,5%,500V	59660	811-565B202J
C4550	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	59660	831610Y5U0102P
C4580	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	59660	831610Y5U0102P
C4601	283-0104-00			CAP.,FXD,CER DI:2000PF,5%,500V	59660	811-565B202J
C4611	281-0604-00			CAP.,FXD,CER DI:2.2PF,+/-0.25PF,500V	04222	7001-C0J-2R2C
C4616	281-0610-00			CAP.,FXD,CER DI:2.2PF,+/-0.1PF,500V	59660	374-018COJ0229B
C4620	281-0091-00	B060000	B094089	CAP.,VAR,CER DI:2-8PF,350V	59660	538-011 A2-8
C4620	----- -----			(1480C,1481C,1482,1485C ONLY)		
C4620	281-0153-00	B094090		CAP.,VAR,AIR DI:1.7-10PF,250V	74970	187-0106-005
C4620	----- -----			(1480C,1481C,1482C,1485C ONLY)		
C4620	281-0091-00	B060000	B104064	CAP.,VAR,CER DI:2-8PF,350V	59660	538-011 A2-8
C4620	----- -----			(1480R,1481R,1482R,1485R ONLY)		
C4620	281-0153-00	B104065		CAP.,VAR,AIR DI:1.7-10PF,250V	74970	187-0106-005
C4620	----- -----			(1480R,1481R,1482R,1485R ONLY)		
C4621	283-0602-00			CAP.,FXD,MICA D:53PF,5%,300V	00853	D155E53OJ0
C4670	283-0620-00			CAP.,FXD,MICA D:470PF,1%,300V	T0891	RDM15FD471F03
C4680	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	59660	831610Y5U0102P
C4700	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	59660	831610Y5U0102P
C4710	283-0630-00			CAP.,FXD,MICA D:110PF,1%,100V	00853	D155F111F0
C4730	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	59660	831610Y5U0102P
C4750	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	59660	831610Y5U0102P
C4751	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	59660	831610Y5U0102P
C4801	285-1050-00	B060000	B080413	CAP.,FXD,PLSTC:0.1UF,1%,200V	14752	230B1C104F
C4801	----- -----			(1480C ONLY)		
C4801	285-0891-03	B080414		CAP.,FXD,PLSTC:0.1UF,1.5-0.25% 100V	80009	285-0891-03
C4801	----- -----			(1480C ONLY)		

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C4801	285-1050-00	B060000	B080412	CAP.,FXD,PLSTC:0.1UF,1%,200V	14752	230B1C104F
C4801	----- -----			(1480R ONLY)		
C4801	285-0891-03	B080413		CAP.,FXD,PLSTC:0.1UF,1.5-0.25% 100V	80009	285-0891-03
C4801	----- -----			(1480R ONLY)		
C4801	285-1050-00	B060000	B073388	CAP.,FXD,PLSTC:0.1UF,1%,200V	14752	230B1C104F
C4801	----- -----			(1481C ONLY)		
C4801	285-0891-03	B073389		CAP.,FXD,PLSTC:0.1UF,1.5-0.25% 100V	80009	285-0891-03
C4801	----- -----			(1481C ONLY)		
C4801	285-1050-00	B060000	B080426	CAP.,FXD,PLSTC:0.1UF,1%,200V	14752	230B1C104F
C4801	----- -----			(1481R ONLY)		
C4801	285-0891-03	B080427		CAP.,FXD,PLSTC:0.1UF,1.5-0.25% 100V	80009	285-0891-03
C4801	----- -----			(1481R ONLY)		
C4801	285-1050-00	B060000	B073221	CAP.,FXD,PLSTC:0.1UF,1%,200V	14752	230B1C104F
C4801	----- -----			(1482C ONLY)		
C4801	285-0891-03	B073222		CAP.,FXD,PLSTC:0.1UF,1.5-0.25% 100V	80009	285-0891-03
C4801	----- -----			(1482C ONLY)		
C4801	285-1050-00	B060000	B080358	CAP.,FXD,PLSTC:0.1UF,1%,200V	14752	230B1C104F
C4801	----- -----			(1482R ONLY)		
C4801	285-0891-03	B080359		CAP.,FXD,PLSTC:0.1UF,1.5-0.25% 100V	80009	285-0891-03
C4801	----- -----			(1482R ONLY)		
C4801	285-1050-00	B060000	B073372	CAP.,FXD,PLSTC:0.1UF,1%,200V	14752	230B1C104F
C4801	----- -----			(1485C ONLY)		
C4801	285-0891-03	B073373		CAP.,FXD,PLSTC:0.1UF,1.5-0.25% 100V	80009	285-0891-03
C4801	----- -----			(1485C ONLY)		
C4801	285-1050-00	B060000	B080413	CAP.,FXD,PLSTC:0.1UF,1%,200V	14752	230B1C104F
C4801	----- -----			(1485R ONLY)		
C4801	285-0891-03	B080414		CAP.,FXD,PLSTC:0.1UF,1.5-0.25% 100V	80009	285-0891-03
C4801	----- -----			(1485R ONLY)		
C4802	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	59660	831610Y5U0102P
C4820	281-0510-00			CAP.,FXD,CER DI:22PF,+/-4.4PF,500V	59660	301-000C0G0220M
C4821	290-0517-00			CAP.,FXD,ELCTLT:6.8UF,20%,35V	90201	TDC685M035FL
C4822	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	59660	831610Y5U0102P
C4829	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	59660	831610Y5U0102P
C4831	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	59660	831610Y5U0102P
C4850	283-0620-00			CAP.,FXD,MICA D:470PF,1%,300V	T0891	RDM15FD471F03
C4880	283-0028-00			CAP.,FXD,CER DI:0.0022UF,20%,50V	59660	0805585Y5SO222M
C4881	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	59660	831610Y5U0102P
C4891	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	59660	831610Y5U0102P
C4892	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	59660	831610Y5U0102P
C4896	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	59660	831610Y5U0102P
C4897	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	59660	831610Y5U0102P
C4900	290-0535-00			CAP.,FXD,ELCTLT:33UF,20%,10V	56289	196D336X0010KA1
C4900	----- -----			(OPTION 07 ONLY)		
C4901	290-0535-00			CAP.,FXD,ELCTLT:33UF,20%,10V	56289	196D336X0010KA1
C4901	----- -----			(OPTION 07 ONLY)		
C4910	283-0081-00			CAP.,FXD,CER DI:0.1UF,+80-20%,25V	59821	2DDU69E104Z
C4911	281-0549-00			CAP.,FXD,CER DI:68PF,10%,500V	59660	301-000U2J0680K
C4913	283-0637-00			CAP.,FXD,MICA D:20PF,2.5%,100V	00853	D151E200D0
C4913	----- -----			(OPTION 07 ONLY)		
C4921	283-0637-00			CAP.,FXD,MICA D:20PF,2.5%,100V	00853	D151E200D0
C4930	283-0081-00			CAP.,FXD,CER DI:0.1UF,+80-20%,25V	59821	2DDU69E104Z
C4960	281-0558-00			CAP.,FXD,CER DI:18PF,10%,500V	59660	301-000C0G0180K
C4970	283-0680-00			CAP.,FXD,MICA D:330PF,1%,500V	00853	D155F331F0
C4980	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	59660	831610Y5U0102P

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C6043	281-0504-00			CAP.,FXD,CER DI:10PF,+/-1PF,500V	59660	301000C0G0100F
C6044	281-0638-00			CAP.,FXD,CER DI:240PF,5%,500V	72982	301000Z5D241J
C6070	290-0517-00			CAP.,FXD,ELCTLT:6.8UF,20%,35V	90201	TDC685M035FL
C6084	290-0747-00			CAP.,FXD,ELCTLT:100UF,+50-10%,25V	56289	500D148
C6143	281-0504-00			CAP.,FXD,CER DI:10PF,+/-1PF,500V	59660	301000C0G0100F
C6144	281-0550-00			CAP.,FXD,CER DI:120PF,10%,500V	59660	301000X5P121K
C6180	281-0523-00			CAP.,FXD,CER DI:100PF,+/-20PF,500V	59660	301-000U2M0101M
C6190	290-0747-00			CAP.,FXD,ELCTLT:100UF,+50-10%,25V	56289	500D148
C6244	283-0669-00			CAP.,FXD,MICA D:360PF,1%,500V	00853	D155F361F0
C6278	290-0582-00			CAP.,FXD,ELCTLT:5UF,+75-10%,150V	90201	TT5RON150C0P3P
C6280	290-0194-00			CAP.,FXD,ELCTLT:10UF,+50-10%,100V	56289	30D106F100C9
C6322	283-0119-00			CAP.,FXD,CER DI:2200PF,5%,200V	59660	855-536Y5E0222J
C6326	283-0128-00			CAP.,FXD,CER DI:100PF,5%,500V	59660	871-536T2H101J
C6360	290-0442-00			CAP.,FXD,ELCTLT:120UF,+75-10%,150V	56289	39D1197
C6425	285-0622-00			CAP.,FXD,PLSTC:0.1UF,20%,100V	56289	192P10402M474
C6430	283-0058-00			CAP.,FXD,CER DI:0.027UF,10%,100V	56289	1C20X7R273K100B
C6432	290-0523-00			CAP.,FXD,ELCTLT:2.2UF,20%,20V	56289	196D225X0020HA1
C6434	283-0057-00			CAP.,FXD,CER DI:0.1UF,+80-20%,200V	56289	2C20Z5U104Z200B
C6438	281-0504-00			CAP.,FXD,CER DI:10PF,+/-1PF,500V	59660	301000C0G0100F
C6440	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	59821	SDDH69J203Z
C6446	283-0057-00			CAP.,FXD,CER DI:0.1UF,+80-20%,200V	56289	2C20Z5U104Z200B
C6448	283-0002-00			CAP.,FXD,CER DI:0.01UF,+80-20%,500V	59821	D103Z47Z5ULDCEX
C6468	281-0064-00			CAP.,VAR,PLSTC:0.25-1.5PF,600V	74970	273-0001-101
C6472	283-0002-00			CAP.,FXD,CER DI:0.01UF,+80-20%,500V	59821	D103Z47Z5ULDCEX
C6474	290-0534-00			CAP.,FXD,ELCTLT:1UF,20%,35V	56289	196D105X0035HA1
C6535	283-0111-00			CAP.,FXD,CER DI:0.1UF,20%,50V	96733	ADVISE
C6560	283-0328-00			CAP.,FXD,CER DI:0.03UF,+80-20%,200V	51642	300-200-Z5U-303Z
C6564	283-0328-00			CAP.,FXD,CER DI:0.03UF,+80-20%,200V	51642	300-200-Z5U-303Z
C6600	283-0002-00			CAP.,FXD,CER DI:0.01UF,+80-20%,500V	59821	D103Z47Z5ULDCEX
C6602	283-0002-00			CAP.,FXD,CER DI:0.01UF,+80-20%,500V	59821	D103Z47Z5ULDCEX
C6615	290-0194-00			CAP.,FXD,ELCTLT:10UF,+50-10%,100V	56289	30D106F100C9
C6636	290-0746-00			CAP.,FXD,ELCTLT:47UF,+50-10%,16V	55680	ULA1C470TEA
C6648	283-0177-00			CAP.,FXD,CER DI:1UF,+80-20%,25V	04222	SR302E105ZAA
C6649	283-0198-00			CAP.,FXD,CER DI:0.22UF,20%,50V	04222	ADVISE
C6662	283-0328-00			CAP.,FXD,CER DI:0.03UF,+80-20%,200V	51642	300-200-Z5U-303Z
C6670	283-0328-00			CAP.,FXD,CER DI:0.03UF,+80-20%,200V	51642	300-200-Z5U-303Z
C6696	290-0164-00			CAP.,FXD,ELCTLT:1UF,+50-10%,150V	56289	500D105F150BA7
C6704	283-0002-00			CAP.,FXD,CER DI:0.01UF,+80-20%,500V	59821	D103Z47Z5ULDCEX
C6708	283-0002-00			CAP.,FXD,CER DI:0.01UF,+80-20%,500V	59821	D103Z47Z5ULDCEX
C6738	283-0002-00			CAP.,FXD,CER DI:0.01UF,+80-20%,500V	59821	D103Z47Z5ULDCEX
C6752	281-0513-00			CAP.,FXD,CER DI:27PF,+/-5.4PF,500V	59660	301-055P2G0270M
C6785	283-0162-00	B060000	B062399	CAP.,FXD,CER DI:0.01UF,+80-30%,5000V	59660	3905SF706Y5S103Z
C6785	----- -----			(1480C ONLY)		
C6785	285-0509-01	B062400		CAP.,FXD,PPR DI:0.0068UF,20%,5000V	56289	430P507
C6785	----- -----			(1480C ONLY)		
C6785	283-0162-00	B060000	B066194	CAP.,FXD,CER DI:0.01UF,+80-30%,5000V	59660	3905SF706Y5S103Z
C6785	----- -----			(1480R ONLY)		
C6785	285-0509-01	B066195		CAP.,FXD,PPR DI:0.0068UF,20%,5000V	56289	430P507
C6785	----- -----			(1480R ONLY)		
C6788	283-0021-00			CAP.,FXD,CER DI:0.001UF,20%,5000V	59660	848-556-Y5S-102M
C6805	285-1104-00	B060000	B080964	CAP.,FXD,PLSTC:0.033UF,5%,200V	19396	333J02PP580
C6805	----- -----			(1480R ONLY)		
C6805	285-1200-00	B080965		CAP.,FXD,PLSTC:.022UF,5%,200V	14752	950D1C223J
C6805	----- -----			(1480R ONLY)		

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C6805	285-1104-00	B060000	B073458	CAP.,FXD,PLSTC:0.033UF,5%,200V	19396	333J02PP580
C6805	----- -----			(1480C ONLY)		
C6805	285-1200-00	B073459		CAP.,FXD,PLSTC:.022UF,5%,200V	14752	950D1C223J
C6805	----- -----			(1480C ONLY)		
C6830	283-0001-00			CAP.,FXD,CER DI:0.005UF,+100-0%,500V	59821	2DDH61L502P
C6832	281-0504-00			CAP.,FXD,CER DI:10PF,+/-1PF,500V	59660	301000C0G0100F
C6848	283-0162-00	B060000	B062399	CAP.,FXD,CER DI:0.01UF,+80-30%,5000V	59660	3905SF706Y5S103Z
C6848	----- -----			(1480C ONLY)		
C6848	285-0509-01	B062400		CAP.,FXD,PPR DI:0.0068UF,20%,5000V	56289	430P507
C6848	----- -----			(1480C ONLY)		
C6848	283-0162-00	B060000	B066194	CAP.,FXD,CER DI:0.01UF,+80-30%,5000V	59660	3905SF706Y5S103Z
C6848	----- -----			(1480R ONLY)		
C6848	285-0509-01	B066195		CAP.,FXD,PPR DI:0.0068UF,20%,5000V	56289	430P507
C6848	----- -----			(1480R ONLY)		
C6860	283-0162-00	B060000	B062399	CAP.,FXD,CER DI:0.01UF,+80-30%,5000V	59660	3905SF706Y5S103Z
C6860	----- -----			(1480C ONLY)		
C6860	285-0509-01	B062400		CAP.,FXD,PPR DI:0.0068UF,20%,5000V	56289	430P507
C6860	----- -----			(1480C ONLY)		
C6860	283-0162-00	B060000	B066194	CAP.,FXD,CER DI:0.01UF,+80-30%,5000V	59660	3905SF706Y5S103Z
C6860	----- -----			(1480R ONLY)		
C6860	285-0509-01	B066195		CAP.,FXD,PPR DI:0.0068UF,20%,5000V	56289	430P507
C6860	----- -----			(1480R ONLY)		
C6870	283-0021-00			CAP.,FXD,CER DI:0.001UF,20%,5000V	59660	848-556-Y5S-102M
C6986	283-0021-00			CAP.,FXD,CER DI:0.001UF,20%,5000V	59660	848-556-Y5S-102M
C8021	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	59821	SDDH69J203Z
C8021	----- -----			(1482 ONLY)		
C9030	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	59660	831610Y5U0102P
C9032	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	59660	831610Y5U0102P
C9034	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	59660	831610Y5U0102P
C9035	283-0178-00			CAP.,FXD,CER DI:0.1UF,+80-20%,100V	04222	ADVISE
C9040	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	59660	831610Y5U0102P
C9418	283-0134-00			CAP.,FXD,CER DI:0.47UF,+80-20%,50V	04222	ADVISE
C9418	----- -----			(OPTION 07 ONLY)		
C9421	283-0198-00			CAP.,FXD,CER DI:0.22UF,20%,50V	04222	ADVISE
C9421	----- -----			(OPTION 07 ONLY)		
C9438	290-0770-00			CAP.,FXD,ELCTLT:100UF,+50-10%,25V	54473	ECE-A25V100L
C9438	----- -----			(OPTION 07 ONLY)		
C9446	283-0194-00			CAP.,FXD,CER DI:4.7UF,20%,50V	56289	5C37Z5U475M050B
C9446	----- -----			(OPTION 07 ONLY)		
C9459	283-0083-00			CAP.,FXD,CER DI:0.0047UF,20%,500V	72982	811-565C471J
C9459	----- -----			(OPTION 07 ONLY)		
C9510	290-0704-00			CAP.,FXD,ELCTLT:250UF,+50-10%,150V	90201	20-24550
C9520	290-0705-00			CAP.,FXD,ELCTLT:4500UF,+75-10%,30V	90201	20-24551
C9530	290-0705-00			CAP.,FXD,ELCTLT:4500UF,+75-10%,30V	90201	20-24551
CR1004	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR1058	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR1071	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR1107	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR1108	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR1111	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR1112	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR1114	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR1116	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR1123	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)

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CR1144	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR1145	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR1147	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR1158	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR1204	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR1221	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR1222	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR1234	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR1243	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR1301	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR1321	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR1322	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR1323	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR1325	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR1351	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR1353	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR1355	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR1364	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR1563	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR1629	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR1631	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR1633	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR1634	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR1721	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR1741	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR1743	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR1744	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR1748	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR1763	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR1765	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR1767	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR1771	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR1773	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR1774	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR1776	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR1777	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR1794	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR1853	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR1865	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR1947	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR1956	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR1981	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR1987	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR2248	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR2248	----- -----			(OPTION 01 ONLY)		
CR2257	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR2257	----- -----			(OPTION 01 ONLY)		
CR3012	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR3040	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR3050	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR3082	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR3150	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR3200	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR3269	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
CR3274	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR3280	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR3281	152-0246-00			SEMICOND DEVICE:SW,SI,40V,200MA	14433	WG1537TK
CR3300	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR3301	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR3302	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR3310	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR3311	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR3312	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR3319	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR3320	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR3321	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR3330	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR3331	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR3332	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR3333	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR3360	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR3430	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR3460	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR3461	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR3480	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR3490	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR3491	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR4024	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR4030	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR4040	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR4090	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR4091	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR4110	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR4130	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR4132	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR4143	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR4150	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR4151	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR4153	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR4154	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR4155	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR4170	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR4190	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR4191	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR4220	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR4221	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR4250	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR4350	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR4370	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR4390	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR4421	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR4424	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR4428	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR4470	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR4590	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR4591	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR4592	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR4636	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
CR4638	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR4640	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR4651	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR4690	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR4691	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR4732	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR4733	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR4734	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR4760	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR4782	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR6010	152-0488-00	B060000	B062556	SEMICOND DEVICE:SILICON,200V,1500MA	04713	SDA317
CR6010	----- -----			(1480C ONLY)		
CR6010	152-0488-01	B062557		SEMICOND DEVICE:SILICON,200V,0.5A,SEL	80009	152-0488-01
CR6010	----- -----			(1480C ONLY)		
CR6010	152-0488-00	B060000	B067570	SEMICOND DEVICE:SILICON,200V,1500MA	04713	SDA317
CR6010	----- -----			(1480R ONLY)		
CR6010	152-0488-01	B067571		SEMICOND DEVICE:SILICON,200V,0.5A,SEL	80009	152-0488-01
CR6010	----- -----			(1480R ONLY)		
CR6050	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR6074	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR6086	152-0107-00			SEMICOND DEVICE:SILICON,400V,400MA	12969	G727
CR6110	152-0488-00	B060000	B062556	SEMICOND DEVICE:SILICON,200V,1500MA	04713	SDA317
CR6110	----- -----			(1480C ONLY)		
CR6110	152-0488-01	B062557		SEMICOND DEVICE:SILICON,200V,0.5A,SEL	80009	152-0488-01
CR6110	----- -----			(1480C ONLY)		
CR6110	152-0488-00	B060000	B067570	SEMICOND DEVICE:SILICON,200V,1500MA	04713	SDA317
CR6110	----- -----			(1480R ONLY)		
CR6110	152-0488-01	B067571		SEMICOND DEVICE:SILICON,200V,0.5A,SEL	80009	152-0488-01
CR6110	----- -----			(1480R ONLY)		
CR6150	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR6186	152-0107-00			SEMICOND DEVICE:SILICON,400V,400MA	12969	G727
CR6210	152-0488-00	B060000	B062556	SEMICOND DEVICE:SILICON,200V,1500MA	04713	SDA317
CR6210	----- -----			(1480C ONLY)		
CR6210	152-0488-01	B062557		SEMICOND DEVICE:SILICON,200V,0.5A,SEL	80009	152-0488-01
CR6210	----- -----			(1480C ONLY)		
CR6210	152-0488-00	B060000	B067570	SEMICOND DEVICE:SILICON,200V,1500MA	04713	SDA317
CR6210	----- -----			(1480R ONLY)		
CR6210	152-0488-01	B067571		SEMICOND DEVICE:SILICON,200V,0.5A,SEL	80009	152-0488-01
CR6210	----- -----			(1480R ONLY)		
CR6236	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR6250	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR6274	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR6310	152-0488-00	B060000	B062556	SEMICOND DEVICE:SILICON,200V,1500MA	04713	SDA317
CR6310	----- -----			(1480C ONLY)		
CR6310	152-0488-01	B062557		SEMICOND DEVICE:SILICON,200V,0.5A,SEL	80009	152-0488-01
CR6310	----- -----			(1480C ONLY)		
CR6310	152-0488-00	B060000	B067570	SEMICOND DEVICE:SILICON,200V,1500MA	04713	SDA317
CR6310	----- -----			(1480R ONLY)		
CR6310	152-0488-01	B067571		SEMICOND DEVICE:SILICON,200V,0.5A,SEL	80009	152-0488-01
CR6310	----- -----			(1480R ONLY)		
CR6334	152-0107-00			SEMICOND DEVICE:SILICON,400V,400MA	12969	G727
CR6370	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR6429	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR6490	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
CR6678	152-0061-00			SEMICOND DEVICE:SILICON,175V,100MA	07263	FDH2161
CR6680	152-0061-00			SEMICOND DEVICE:SILICON,175V,100MA	07263	FDH2161
CR6690	152-0107-00			SEMICOND DEVICE:SILICON,400V,400MA	12969	G727
CR6694	152-0107-00			SEMICOND DEVICE:SILICON,400V,400MA	12969	G727
CR6728	152-0400-00			SEMICOND DEVICE:SILICON,400V,1A	80009	1N4936
CR6730	152-0400-00			SEMICOND DEVICE:SILICON,400V,1A	80009	1N4936
CR6736	152-0400-00			SEMICOND DEVICE:SILICON,400V,1A	80009	1N4936
CR6738	152-0061-00			SEMICOND DEVICE:SILICON,175V,100MA	07263	FDH2161
CR6742	152-0061-00			SEMICOND DEVICE:SILICON,175V,100MA	07263	FDH2161
CR6888	152-0061-00			SEMICOND DEVICE:SILICON,175V,100MA	07263	FDH2161
CR6890	152-0061-00			SEMICOND DEVICE:SILICON,175V,100MA	07263	FDH2161
CR6942	152-0409-00			SEMICOND DEVICE:SILICON,12,000V,5MA	83003	VG12X-1
CR6956	152-0107-00			SEMICOND DEVICE:SILICON,400V,400MA	12969	G727
CR7170	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR7170	----- -----			(OPTION 04 ONLY)		
CR7190	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR7190	----- -----			(OPTION 04 ONLY)		
CR8001	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR8001	----- -----			(1482 ONLY)		
CR8029	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR8029	----- -----			(1482 ONLY)		
CR8035	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR8035	----- -----			(1482 ONLY)		
CR8036	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR8036	----- -----			(1482 ONLY)		
CR8037	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR8037	----- -----			(1482 ONLY)		
CR8038	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR8038	----- -----			(1482 ONLY)		
CR9428	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR9428	----- -----			(OPTION 07 ONLY)		
CR9434	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR9434	----- -----			(OPTION 07 ONLY)		
CR9435	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR9435	----- -----			(OPTION 07 ONLY)		
CR9448	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR9448	----- -----			(OPTION 07 ONLY)		
CR9449	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	12969	NDP0263 (1N4152)
CR9949	----- -----			(OPTION 07 ONLY)		
DS9820	150-0123-02			LAMP,CARTRIDGE:14V,23MA,RED	55292	71523-01
DS9836	150-0123-03			LAMP,CARTRIDGE:14V,23MA	55292	71523-02
DS9850	150-0004-00			LAMP,INCAND:GE #328	08806	328
DS9855	150-0004-00			LAMP,INCAND:GE #328	08806	328
DS9860	150-0004-00			LAMP,INCAND:GE #328	08806	328
DS9896	150-0123-02			LAMP,CARTRIDGE:14V,23MA,RED	55292	71523-01
DS9896	----- -----			(1481, 1482, 1485 ONLY)		
DS9930	150-0123-00			LAMP,CARTRIDGE:14V,23MA,WHITE	55292	72323-14
DS9940	150-0123-00			LAMP,CARTRIDGE:14V,23MA,WHITE	55292	72323-14
DS9950	150-0059-00			LAMP,INCAND:14V,0.08A	08806	386
DS9960	150-0059-00			LAMP,INCAND:14V,0.08A	08806	386
DS9980	150-0123-02			LAMP,CARTRIDGE:14V,23MA,RED	55292	71523-01
E9400	119-0181-00	B073365		ARSR,ELEC SURGE:230V,GAS FILLED	74276	CG230L
E9400	----- -----			(1480C ONLY)		

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
E9400	119-0181-00	B080177		ARSR,ELEC SURGE:230V,GAS FILLED	74276	CG230L
E9400	----- -----			(1480R ONLY)		
F9185	159-0018-00			FUSE,CARTRIDGE:3AG,0.8A,250V,SLOW-BLOW	71400	MDL 8/10
F9185	----- -----			(FOR 115V OPERATION)		
F9185	159-0031-00			FUSE,CARTRIDGE:3AG,0.4A,250V,SLOW-BLOW	71400	MDL 4/10
F9815	----- -----			(FOR 230V OPERATION)		
FL9190	119-0389-00			FILTER,RAD INTE:115/230V,3A	02777	F11935-3
L1074	114-0303-00			COIL,RF:VARIABLE,6.5-23UH	80009	114-0303-00
L1077	114-0308-00			COIL,RF:VARIABLE,2.9-6.5UH	80009	114-0308-00
L1082	114-0311-00			COIL,RF:VARIABLE,65-190UH	80009	114-0311-00
L1083	114-0311-00			COIL,RF:VARIABLE,65-190UH	80009	114-0311-00
L1094	114-0340-00			COIL,RF:VARIABLE,350-750UH	80009	114-0340-00
L1172	114-0303-00			COIL,RF:VARIABLE,6.5-23UH	80009	114-0303-00
L1191	114-0219-00			COIL,RF:VARIABLE,43-130UH	80009	114-0219-00
L1287	114-0310-00			COIL,RF:VARIABLE,22-80UH	80009	114-0310-00
L1294	114-0254-00			COIL,RF:VARIABLE,30-60UH	80009	114-0254-00
L1294	----- -----			(1481, 1482, 1485 ONLY)		
L1374	114-0259-00			COIL,RF:VARIABLE,150-240UH	80009	114-0259-00
L1385	114-0259-00			COIL,RF:VARIABLE,150-240UH	80009	114-0259-00
L1395	114-0219-00			COIL,RF:VARIABLE,43-130UH	80009	114-0219-00
L1576	114-0308-00			COIL,RF:VARIABLE,2.9-6.5UH	80009	114-0308-00
L1605	114-0308-00	B060000	B079999	COIL,RF:VARIABLE,2.9-6.5UH	80009	114-0308-00
L1605	----- -----			(1480C ONLY)		
L1605	114-0308-00	B060000	B089999	COIL,RF:VARIABLE,2.9-6.5UH	80009	114-0308-00
L1605	----- -----			(1480R ONLY)		
L1658	108-0561-00	B060000	B079999	COIL,RF:3.75UH	80009	108-0561-00
L1658	----- -----			(1480C ONLY)		
L1658	108-0561-00	B060000	B089999	COIL,RF:3.75UH	80009	108-0561-00
L1658	----- -----			(1480R ONLY)		
L1662	108-0561-00	B060000	B079999	COIL,RF:3.75UH	80009	108-0561-00
L1662	----- -----			(1480C ONLY)		
L1662	108-0561-00	B060000	B089999	COIL,RF:3.75UH	80009	108-0561-00
L1662	----- -----			(1480R ONLY)		
L1697	114-0343-00			COIL,RF:200-400UH,CORE 276-0568-00	80009	114-0343-00
L1707	114-0308-00	B060000	B079999	COIL,RF:VARIABLE,2.9-6.5UH	80009	114-0308-00
L1707	----- -----			(1480C ONLY)		
L1707	114-0308-00	B060000	B089999	COIL,RF:VARIABLE,2.9-6.5UH	80009	114-0308-00
L1707	----- -----			(1480R ONLY)		
L6510	108-0205-00			COIL,RF:1MH	76493	8209
L6546	108-0473-00			COIL,RF:150UH	80009	108-0473-00
L6627	108-0809-00			COIL,RF:FIXED,3.12MH	80009	108-0809-00
L9350	108-0804-00			COIL,TUBE DEFL:X-Y ALIGNMENT	80009	108-0804-00
L9650	108-0805-00			COIL,TUBE DEFL:TRACE ROTATOR	80009	108-0805-00
LR1603	108-0807-00	B060000	B079999	COIL,RF:8.5UH	80009	108-0807-00
LR1603	----- -----			(1480C ONLY)		
LR1603	108-1167-00	B080000		COIL,RF:FIXED,5.5UH	80009	108-1167-00
LR1603	----- -----			(1480C ONLY)		
LR1603	108-0807-00	B060000	B089999	COIL,RF:8.5UH	80009	108-0807-00
LR1603	----- -----			(1480R ONLY)		
LR1603	108-1167-00	B090000		COIL,RF:FIXED,5.5UH	80009	108-1167-00
LR1603	----- -----			(1480R ONLY)		
LR1703	108-0807-00	B060000	B079999	COIL,RF:8.5UH	80009	108-0807-00
LR1703	----- -----			(1480C ONLY)		
LR1703	108-1167-00	B080000		COIL,RF:FIXED,5.5UH	80009	108-1167-00
LR1703	----- -----			(1480C ONLY)		

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
LR1703	108-0807-00	B060000	B089999	COIL,RF:8.5UH	80009	108-0807-00
LR1703	----- -----			(1480R ONLY)		
LR1703	108-1167-00	B090000		COIL,RF:FIXED,5.5UH	80009	108-1167-00
LR1703	----- -----			(1480R ONLY)		
LR3001	108-0111-00			COIL,RF:5.5UH	80009	108-0111-00
LR3050	108-0114-00			COIL,RF:47UH	80009	108-0114-00
LR3108	108-0111-00			COIL,RF:5.5UH	80009	108-0111-00
LR3200	108-0111-00			COIL,RF:5.5UH	80009	108-0111-00
LR4160	108-0226-00			COIL,RF:100UH	76493	DWG B4257
LR6912	108-0806-00			COIL,RF:5.5UH	80009	108-0806-00
Q1007	151-0410-00			TRANSISTOR:SILICON,PNP	04713	SPS6765
Q1008	151-0230-00			TRANSISTOR:SILICON,NPN	01295	SAC6176
Q1024	151-0410-00			TRANSISTOR:SILICON,PNP	04713	SPS6765
Q1025	151-0410-00			TRANSISTOR:SILICON,PNP	04713	SPS6765
Q1026	151-0192-00			TRANSISTOR:SELECTED	04713	SPS8801
Q1036	151-0410-00			TRANSISTOR:SILICON,PNP	04713	SPS6765
Q1037	151-0190-00			TRANSISTOR:NPN,SI,TO-92	04713	SPS7969
Q1051	151-0410-00			TRANSISTOR:SILICON,PNP	04713	SPS6765
Q1052	151-0410-00			TRANSISTOR:SILICON,PNP	04713	SPS6765
Q1054	151-0192-00			TRANSISTOR:SELECTED	04713	SPS8801
Q1062	151-0410-00			TRANSISTOR:SILICON,PNP	04713	SPS6765
Q1063	151-0230-00			TRANSISTOR:SILICON,NPN	01295	SAC6176
Q1121	151-0333-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS918	04713	SPS1752
Q1127	151-0333-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS918	04713	SPS1752
Q1136	151-0192-00			TRANSISTOR:SELECTED	04713	SPS8801
Q1136	----- -----			(END USAGE 670-3485-29 1480C/1480R ONLY)		
Q1136	151-0333-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS918	04713	SPS1752
Q1136	----- -----			(END USAGE 670-3485-34 1480C/1480R ONLY)		
Q1136	151-0192-00			TRANSISTOR:SELECTED	04713	SPS8801
Q1136	----- -----			(BEGIN USAGE 670-3485-39 1480C/1480R ONLY)		
Q1136	151-0333-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS918	04713	SPS1752
Q1136	----- -----			(END USAGE 670-3485-37 1481C/1481R,		
Q1136	----- -----			1482C/1482R,1485C/1485R ONLY)		
Q1136	151-0192-00			TRANSISTOR:SELECTED	04713	SPS8801
Q1136	----- -----			(BEGIN USAGE 670-3485-42 1481C/R,1482C/R,		
Q1136	----- -----			1485C/R ONLY)		
Q1136	151-0333-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS918	04713	SPS1752
Q1136	----- -----			(END USAGE 670-3485-35 1480C,1482C,		
Q1136	----- -----			1485C OPTION 04 ONLY)		
Q1136	151-0192-00			TRANSISTOR:SELECTED	04713	SPS8801
Q1136	----- -----			(BEGIN USAGE 670-3485-40 1480C,1482C,		
Q1136	----- -----			1485C OPTION 04 ONLY)		
Q1136	151-0333-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS918	04713	SPS1752
Q1136	----- -----			(END USAGE 670-3485-38 1481C,1485C,		
Q1136	----- -----			OPTION 04 ONLY)		
Q1136	151-0192-00			TRANSISTOR:SELECTED	04713	SPS8801
Q1136	----- -----			(BEGIN USAGE 670-3485-43 1481C,1485C,		
Q1136	----- -----			OPTION 04 ONLY)		
Q1137	151-0192-00			TRANSISTOR:SELECTED	04713	SPS8801
Q1137	----- -----			(END USAGE 670-3485-29 1480C/1480R ONLY)		
Q1137	151-0333-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS918	04713	SPS1752
Q1137	----- -----			(END USAGE 670-3485-34 1480C/1480R ONLY)		
Q1137	151-0192-00			TRANSISTOR:SELECTED	04713	SPS8801
Q1137	----- -----			(BEGIN USAGE 670-3485-39 1480C/1480R ONLY)		

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
Q1137	151-0333-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS918	04713	SPS1752
Q1137	----- -----			(END USAGE 670-3485-37 1481C/1481R,		
Q1137	----- -----			1482C/1482R,1485C/1485R ONLY)		
Q1137	151-0192-00			TRANSISTOR:SELECTED	04713	SPS8801
Q1137	----- -----			(BEGIN USAGE 670-3485-42 1481C/R,1482C/R,		
Q1137	----- -----			1485C/R ONLY)		
Q1137	151-0333-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS918	04713	SPS1752
Q1137	----- -----			(END USAGE 670-3485-35 1480C,1482C,		
Q1137	----- -----			1485C OPTION 04 ONLY)		
Q1137	151-0192-00			TRANSISTOR:SELECTED	04713	SPS8801
Q1137	----- -----			(BEGIN USAGE 670-3485-40 1480C,1482C,		
Q1137	----- -----			1485C OPTION 04 ONLY)		
Q1137	151-0333-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS918	04713	SPS1752
Q1137	----- -----			(END USAGE 670-3485-38 1481C,1485C		
Q1137	----- -----			OPTION 04 ONLY)		
Q1137	151-0192-00			TRANSISTOR:SELECTED	04713	SPS8801
Q1137	----- -----			(BEGIN USAGE 670-3485-43 1481C,1485C		
Q1137	----- -----			OPTION 04 ONLY)		
Q1141	151-0192-00			TRANSISTOR:SELECTED	04713	SPS8801
Q1141	----- -----			(END USAGE 670-3485-29 1480C/1480R ONLY)		
Q1141	151-0333-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS918	04713	SPS1752
Q1141	----- -----			(END USAGE 670-3485-34 1480C/1480R ONLY)		
Q1141	151-0192-00			TRANSISTOR:SELECTED	04713	SPS8801
Q1141	----- -----			(BEGIN USAGE 670-3485-39 1480C/1480R ONLY)		
Q1141	151-0333-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS918	04713	SPS1752
Q1141	----- -----			(END USAGE 670-3485-37 1481C/1481R		
Q1141	----- -----			.1482C/1482R,1485C/1485R ONLY)		
Q1141	151-0192-00			TRANSISTOR:SELECTED	04713	SPS8801
Q1141	----- -----			(BEGIN USAGE 670-3485-42 1481C/R,1482C/R		
Q1141	----- -----			.1485C/R ONLY)		
Q1141	151-0333-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS918	04713	SPS1752
Q1141	----- -----			(END USAGE 670-3485-35 1480C,1482C		
Q1141	----- -----			,1485C OPTION 04 ONLY)		
Q1141	151-0192-00			TRANSISTOR:SELECTED	04713	SPS8801
Q1141	----- -----			(BEGIN USAGE 670-3485-40 1480C,1482C		
Q1141	----- -----			,1485C OPTION 04 ONLY)		
Q1141	151-0333-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS918	04713	SPS1752
Q1141	----- -----			(END USAGE 670-3485-38 1481C,1485C		
Q1141	----- -----			OPTION 04 ONLY)		
Q1141	151-0192-00			TRANSISTOR:SELECTED	04713	SPS8801
Q1141	----- -----			(BEGIN USAGE 670-3485-43 1481C,1485C		
Q1141	----- -----			OPTION 04 ONLY)		
Q1142	151-0192-00			TRANSISTOR:SELECTED	04713	SPS8801
Q1142	----- -----			(END USAGE 670-3485-29 1480C/1480R ONLY)		
Q1142	151-0333-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS918	04713	SPS1752
Q1142	----- -----			(END USAGE 670-3485-34 1480C/1480R ONLY)		
Q1142	151-0192-00			TRANSISTOR:SELECTED	04713	SPS8801
Q1142	----- -----			(BEGIN USAGE 670-3485-39 1480C/1480R ONLY)		
Q1142	151-0333-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS918	04713	SPS1752
Q1142	----- -----			(END USAGE 670-3485-37 1481C/1481R		
Q1142	----- -----			.1482C/1482R,1485C/1485R ONLY)		
Q1142	151-0192-00			TRANSISTOR:SELECTED	04713	SPS8801
Q1142	----- -----			(BEGIN USAGE 670-3485-42 1481C/R,1482C/R		
Q1142	----- -----			.1485C/R ONLY)		

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
Q1142	151-0333-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS918	04713	SPS1752
Q1142	----- -----			(END USAGE 670-3485-35 1480C,1482C		
Q1142	----- -----			,1485C OPTION 04 ONLY)		
Q1142	151-0192-00			TRANSISTOR:SELECTED	04713	SPS8801
Q1142	----- -----			(BEGIN USAGE 670-3485-40 1480C,1482C		
Q1142	----- -----			,1485C OPTION 04 ONLY)		
Q1142	151-0333-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS918	04713	SPS1752
Q1142	----- -----			(END USAGE 670-3485-38 1481C,1485C		
Q1142	----- -----			OPTION 04 ONLY)		
Q1142	151-0192-00			TRANSISTOR:SELECTED	04713	SPS8801
Q1142	----- -----			(BEGIN USAGE 670-3485-43 1481C,1485C		
Q1142	----- -----			OPTION 04 ONLY)		
Q1155	151-0410-00			TRANSISTOR:SILICON,PNP	04713	SPS6765
Q1157	151-0333-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS918	04713	SPS1752
Q1227	151-0333-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS918	04713	SPS1752
Q1236	151-0190-00			TRANSISTOR:NPN,SI,TO-92	04713	SPS7969
Q1241	151-0188-00			TRANSISTOR:PNP,SI,TO-92	04713	SPS6868
Q1242	151-0188-00			TRANSISTOR:PNP,SI,TO-92	04713	SPS6868
Q1253	151-0230-00			TRANSISTOR:SILICON,NPN	01295	SAC6176
Q1303	151-0220-00			TRANSISTOR:PNP,SI,TO-92	07263	S036228
Q1322	151-0410-00			TRANSISTOR:SILICON,PNP	04713	SPS6765
Q1340	151-0190-00			TRANSISTOR:NPN,SI,TO-92	04713	SPS7969
Q1396	151-0410-00			TRANSISTOR:SILICON,PNP	04713	SPS6765
Q1402	151-0410-00			TRANSISTOR:SILICON,PNP	04713	SPS6765
Q1421	151-0190-00			TRANSISTOR:NPN,SI,TO-92	04713	SPS7969
Q1423	151-0220-00			TRANSISTOR:PNP,SI,TO-92	07263	S036228
Q1431	151-0190-00			TRANSISTOR:NPN,SI,TO-92	04713	SPS7969
Q1435	151-0410-00			TRANSISTOR:SILICON,PNP	04713	SPS6765
Q1452	151-0190-00			TRANSISTOR:NPN,SI,TO-92	04713	SPS7969
Q1455	151-0410-00			TRANSISTOR:SILICON,PNP	04713	SPS6765
Q1465	151-0207-00			TRANSISTOR:SILICON,NPN	03508	X32D6191
Q1470	151-0190-00			TRANSISTOR:NPN,SI,TO-92	04713	SPS7969
Q1472	151-0190-00			TRANSISTOR:NPN,SI,TO-92	04713	SPS7969
Q1475	151-0221-00			TRANSISTOR:SILICON,PNP	04713	SPS246
Q1483	151-0207-00			TRANSISTOR:SILICON,NPN	03508	X32D6191
Q1489	151-0302-00			TRANSISTOR:SILICON,NPN	07263	S038487
Q1496	151-0207-00			TRANSISTOR:SILICON,NPN	03508	X32D6191
Q1529	151-0103-00			TRANSISTOR:SILICON,NPN	80009	151-0103-00
Q1542	151-0190-00			TRANSISTOR:NPN,SI,TO-92	04713	SPS7969
Q1617	151-0446-00			TRANSISTOR:SILICON,NPN	80009	151-0446-00
Q1621	151-0302-00	B060000	B079999	TRANSISTOR:SILICON,NPN	07263	S038487
Q1621	----- -----			(1480C ONLY)		
Q1621	151-0127-00	B080000		TRANSISTOR:SILICON,NPN	07263	S006075
Q1621	----- -----			(1480C ONLY)		
Q1621	151-0302-00	B060000	B089999	TRANSISTOR:SILICON,NPN	07263	S038487
Q1621	----- -----			(1480R ONLY)		
Q1621	151-0127-00	B090000		TRANSISTOR:SILICON,NPN	07263	S006075
Q1621	----- -----			(1480R ONLY)		
Q1637	151-0367-00			TRANSISTOR:SILICON,NPN,SEL FROM 3571TP	04713	SPS 8811
Q1654	151-0325-00	B060000	B062556	TRANSISTOR:SILICON,PNP,SEL FROM 2N4258	80009	151-0325-00
Q1654	----- -----			(1480C ONLY)		
Q1654	151-0325-01	B062557		TRANSISTOR:SILICON,PNP,SEL	80009	151-0325-01
Q1654	----- -----			(1480C ONLY)		

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Q1654	151-0325-00	B060000	B067570	TRANSISTOR:SILICON,PNP,SEL FROM 2N4258	80009	151-0325-00
Q1654	----- -----			(1480R ONLY)		
Q1654	151-0325-01	B067571		TRANSISTOR:SILICON,PNP,SEL	80009	151-0325-01
Q1654	----- -----			(1480R ONLY)		
Q1670	151-0139-00			TRANSISTOR:SILICON,NPN	80009	151-0139-00
Q1691	151-0190-00			TRANSISTOR:NPN,SI,TO-92	04713	SPS7969
Q1723	151-0446-00			TRANSISTOR:SILICON,NPN	80009	151-0446-00
Q1732	151-0302-00	B060000	B079999	TRANSISTOR:SILICON,NPN	07263	S038487
Q1732	----- -----			(1480C ONLY)		
Q1732	151-0127-00	B080000		TRANSISTOR:SILICON,NPN	07263	S006075
Q1732	----- -----			(1480C ONLY)		
Q1732	151-0302-00	B060000	B089999	TRANSISTOR:SILICON,NPN	07263	S038487
Q1732	----- -----			(1480R ONLY)		
Q1732	151-0127-00	B090000		TRANSISTOR:SILICON,NPN	07263	S006075
Q1732	----- -----			(1480R ONLY)		
Q1737	151-0367-00			TRANSISTOR:SILICON,NPN,SEL FROM 3571TP	04713	SPS 8811
Q1747	151-0190-00			TRANSISTOR:NPN,SI,TO-92	04713	SPS7969
Q1754	151-0325-00	B060000	B062556	TRANSISTOR:SILICON,PNP,SEL FROM 2N4258	80009	151-0325-00
Q1754	----- -----			(1480C ONLY)		
Q1754	151-0325-01	B062557		TRANSISTOR:SILICON,PNP,SEL	80009	151-0325-01
Q1754	----- -----			(1480C ONLY)		
Q1754	151-0325-00	B060000	B067570	TRANSISTOR:SILICON,PNP,SEL FROM 2N4258	80009	151-0325-00
Q1754	----- -----			(1480R ONLY)		
Q1754	151-0325-01	B067571		TRANSISTOR:SILICON,PNP,SEL	80009	151-0325-01
Q1754	----- -----			(1480R ONLY)		
Q1775	151-0190-00			TRANSISTOR:NPN,SI,TO-92	04713	SPS7969
Q1785	151-1022-00			TRANSISTOR:FET,N-CHAN,SI,F1782,T0-18	17856	FN1234
Q1793	151-0207-00			TRANSISTOR:SILICON,NPN	03508	X32D6191
Q1805	151-1025-00	B061355		TRANSISTOR:SILICON,JFE,N-CHANNEL	01295	SFB8129
Q1805	----- -----			(1481C,1482C,1485C ONLY)		
Q1805	151-1025-00			TRANSISTOR:SILICON,JFE,N-CHANNEL	01295	SFB8129
Q1805	151-1025-00			TRANSISTOR:SILICON,JFE,N-CHANNEL	01295	SFB8129
Q1805	151-1025-00			TRANSISTOR:SILICON,JFE,N-CHANNEL	01295	SFB8129
Q1847	151-0190-00			TRANSISTOR:NPN,SI,TO-92	04713	SPS7969
Q1861	151-0190-00			TRANSISTOR:NPN,SI,TO-92	04713	SPS7969
Q1875	151-0190-00			TRANSISTOR:NPN,SI,TO-92	04713	SPS7969
Q1891	151-0220-00			TRANSISTOR:PNP,SI,TO-92	07263	S036228
Q2244	151-0221-00			TRANSISTOR:SILICON,PNP	04713	SPS246
Q2244	----- -----			(OPTION 01 ONLY)		
Q2259	151-1025-00			TRANSISTOR:SILICON,JFE,N-CHANNEL	01295	SFB8129
Q2259	----- -----			(OPTION 01 ONLY)		
Q2274	151-0190-00			TRANSISTOR:NPN,SI,TO-92	04713	SPS7969
Q2274	----- -----			(OPTION 01 ONLY)		
Q3020	151-0192-00			TRANSISTOR:SELECTED	04713	SPS8801
Q3031	151-0220-00			TRANSISTOR:PNP,SI,TO-92	07263	S036228
Q3081	151-0190-00			TRANSISTOR:NPN,SI,TO-92	04713	SPS7969
Q3082	151-0220-00			TRANSISTOR:PNP,SI,TO-92	07263	S036228
Q3120	151-0192-00			TRANSISTOR:SELECTED	04713	SPS8801
Q3139	151-0223-00			TRANSISTOR:NPN,SI,TO-92	04713	SPS8026
Q3140	151-0223-00			TRANSISTOR:NPN,SI,TO-92	04713	SPS8026
Q3141	151-0223-00			TRANSISTOR:NPN,SI,TO-92	04713	SPS8026
Q3150	151-0410-00			TRANSISTOR:SILICON,PNP	04713	SPS6765
Q3151	151-0223-00			TRANSISTOR:NPN,SI,TO-92	04713	SPS8026
Q3152	151-0223-00			TRANSISTOR:NPN,SI,TO-92	04713	SPS8026

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Q3170	151-0190-00			TRANSISTOR:NPN,SI,TO-92	04713	SPS7969
Q3230	151-0223-00			TRANSISTOR:NPN,SI,TO-92	04713	SPS8026
Q3241	151-0195-00			TRANSISTOR:SILICON,NPN	04713	SPS8800
Q3252	151-0192-00			TRANSISTOR:SELECTED	04713	SPS8801
Q3270	151-0190-00			TRANSISTOR:NPN,SI,TO-92	04713	SPS7969
Q3272	151-0190-00			TRANSISTOR:NPN,SI,TO-92	04713	SPS7969
Q3273	151-0190-00			TRANSISTOR:NPN,SI,TO-92	04713	SPS7969
Q3280	151-0302-00			TRANSISTOR:SILICON,NPN	07263	S038487
Q3290	151-0192-00			TRANSISTOR:SELECTED	04713	SPS8801
Q3291	151-0223-00			TRANSISTOR:NPN,SI,TO-92	04713	SPS8026
Q3310	151-0302-00			TRANSISTOR:SILICON,NPN	07263	S038487
Q3311	151-0302-00			TRANSISTOR:SILICON,NPN	07263	S038487
Q3320	151-0302-00			TRANSISTOR:SILICON,NPN	07263	S038487
Q3321	151-0302-00			TRANSISTOR:SILICON,NPN	07263	S038487
Q3330	151-0220-00			TRANSISTOR:PNP,SI,TO-92	07263	S036228
Q3350	151-0192-00			TRANSISTOR:SELECTED	04713	SPS8801
Q3351	151-0410-00			TRANSISTOR:SILICON,PNP	04713	SPS6765
Q3372	151-0188-00			TRANSISTOR:PNP,SI,TO-92	04713	SPS6868
Q3373	151-0188-00			TRANSISTOR:PNP,SI,TO-92	04713	SPS6868
Q3390	151-0220-00			TRANSISTOR:PNP,SI,TO-92	07263	S036228
Q3440	151-0192-00			TRANSISTOR:SELECTED	04713	SPS8801
Q3441	151-0192-00			TRANSISTOR:SELECTED	04713	SPS8801
Q3460	151-0198-00			TRANSISTOR:SELECTED	04713	SPS8802-1
Q3470	151-0192-00			TRANSISTOR:SELECTED	04713	SPS8801
Q4020	151-0261-01			TRANSISTOR:SILICON,PNP,DUAL,LOW NOISE	04713	SD441-1
Q4050	151-0190-00			TRANSISTOR:NPN,SI,TO-92	04713	SPS7969
Q4051	151-0410-00			TRANSISTOR:SILICON,PNP	04713	SPS6765
Q4070	151-0188-00			TRANSISTOR:PNP,SI,TO-92	04713	SPS6868
Q4090	151-0188-00			TRANSISTOR:PNP,SI,TO-92	04713	SPS6868
Q4110	151-0216-00			TRANSISTOR:SILICON,PNP	04713	SPS8803
Q4115	151-0192-00			TRANSISTOR:SELECTED	04713	SPS8801
Q4210	151-0232-00			TRANSISTOR:SILICON,NPN,DUAL	07263	SP12141
Q4211	151-0188-00			TRANSISTOR:PNP,SI,TO-92	04713	SPS6868
Q4230	151-0188-00			TRANSISTOR:PNP,SI,TO-92	04713	SPS6868
Q4310	151-0190-00			TRANSISTOR:NPN,SI,TO-92	04713	SPS7969
Q4311	151-0190-00	B060000	B073283	TRANSISTOR:NPN,SI,TO-92	04713	SPS7969
Q4311	----- -----			(1480C ONLY)		
Q4311	151-0190-08	B073284	B084040	TRANSISTOR:2N3904,SELECTED	04713	ORD BY DESCR
Q4311	----- -----			(END USAGE 670-3488-24 1480C,1481C,1482C,		
Q4311	----- -----			,1485C ONLY)		
Q4311	151-0207-00	B084041		TRANSISTOR:SILICON,NPN	03508	X32D6191
Q4311	----- -----			(BEGIN USAGE 670-3488-30 1480C,1481C,1482C,		
Q4311	----- -----			,1485C ONLY)		
Q4311	151-0190-00	B060000	B079771	TRANSISTOR:NPN,SI,TO-92	04713	SPS7969
Q4311	----- -----			(1480R ONLY)		
Q4311	151-0190-08	B079772	B093819	TRANSISTOR:2N3904,SELECTED	04713	ORD BY DESCR
Q4311	----- -----			(END USAGE 670-3488-24 1480R,1481R,1482R,		
Q4311	----- -----			,1485R ONLY)		
Q4311	151-0207-00	B093820		TRANSISTOR:SILICON,NPN	03508	X32D6191
Q4311	----- -----			(BEGIN USAGE 670-3488-30 1480R,1481R,1482R,		
Q4311	----- -----			,1485R ONLY)		
Q4312	151-0190-00	B060000	B073283	TRANSISTOR:NPN,SI,TO-92	04713	SPS7969
Q4312	----- -----			(1480C ONLY)		
Q4312	151-0190-08	B073284		TRANSISTOR:2N3904,SELECTED	04713	ORD BY DESCR
Q4312	----- -----			(1480C ONLY)		

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
Q4312	151-0190-00	B060000	B079771	TRANSISTOR:NPN,SI,TO-92	04713	SPS7969
Q4312	----- -----			(1480R ONLY)		
Q4312	151-0190-08	B079772		TRANSISTOR:2N3904,SELECTED	04713	ORD BY DESCR
Q4312	----- -----			(1480R ONLY)		
Q4313	151-0190-00	B060000	B073283	TRANSISTOR:NPN,SI,TO-92	04713	SPS7969
Q4313	----- -----			(1480C ONLY)		
Q4313	151-0190-08	B073284		TRANSISTOR:2N3904,SELECTED	04713	ORD BY DESCR
Q4313	----- -----			(1480C ONLY)		
Q4313	151-0190-00	B060000	B079771	TRANSISTOR:NPN,SI,TO-92	04713	SPS7969
Q4313	----- -----			(1480R ONLY)		
Q4313	151-0190-08	B079772		TRANSISTOR:2N3904,SELECTED	04713	ORD BY DESCR
Q4313	----- -----			(1480R ONLY)		
Q4321	151-0188-00			TRANSISTOR:PNP,SI,TO-92	04713	SPS6868
Q4322	151-0190-00			TRANSISTOR:NPN,SI,TO-92	04713	SPS7969
Q4323	151-0192-00			TRANSISTOR:SELECTED	04713	SPS8801
Q4400	151-0406-00	B060000	B062556	TRANSISTOR:SILICON,PNP	04713	ST1264
Q4400	----- -----			(1480C ONLY)		
Q4400	151-0406-01	B062557		TRANSISTOR:SILICON,PNP,SCREENED	80009	151-0406-01
Q4400	----- -----			(1480C ONLY)		
Q4400	151-0406-00	B060000	B067570	TRANSISTOR:SILICON,PNP	04713	ST1264
Q4400	----- -----			(1480R ONLY)		
Q4400	151-0406-01	B067571		TRANSISTOR:SILICON,PNP,SCREENED	80009	151-0406-01
Q4400	----- -----			(1480R ONLY)		
Q4410	151-0190-00	B060000	B073283	TRANSISTOR:NPN,SI,TO-92	04713	SPS7969
Q4410	----- -----			(1480C ONLY)		
Q4410	151-0190-08	B073283		TRANSISTOR:2N3904,SELECTED	04713	ORD BY DESCR
Q4410	----- -----			(1480C ONLY)		
Q4410	151-0190-00	B060000	B079771	TRANSISTOR:NPN,SI,TO-92	04713	SPS7969
Q4410	----- -----			(1480R ONLY)		
Q4410	151-0190-08	B079772		TRANSISTOR:2N3904,SELECTED	04713	ORD BY DESCR
Q4410	----- -----			(1480R ONLY)		
Q4411	151-0410-00			TRANSISTOR:SILICON,PNP	04713	SPS6765
Q4500	151-0407-00	B060000	B073283	TRANSISTOR:SILICON,NPN	04713	SS2456
Q4500	----- -----			(1480C ONLY)		
Q4500	151-0407-02	B073284		TRANSISTOR:SS2456,SELECTED	04713	ORDER BY DESCR
Q4500	----- -----			(1480C ONLY)		
Q4500	151-0407-00	B060000	B079771	TRANSISTOR:SILICON,NPN	04713	SS2456
Q4500	----- -----			(1480R ONLY)		
Q4500	151-0407-02	B079772		TRANSISTOR:SS2456,SELECTED	04713	ORDER BY DESCR
Q4500	----- -----			(1480R ONLY)		
Q4510	151-0410-00			TRANSISTOR:SILICON,PNP	04713	SPS6765
Q4511	151-0410-00			TRANSISTOR:SILICON,PNP	04713	SPS6765
Q4520	151-0190-00			TRANSISTOR:NPN,SI,TO-92	04713	SPS7969
Q4521	151-0192-00			TRANSISTOR:SELECTED	04713	SPS8801
Q4522	151-0192-00			TRANSISTOR:SELECTED	04713	SPS8801
Q4530	151-0188-00			TRANSISTOR:PNP,SI,TO-92	04713	SPS6868
Q4531	151-0190-00			TRANSISTOR:NPN,SI,TO-92	04713	SPS7969
Q4540	151-0188-00			TRANSISTOR:PNP,SI,TO-92	04713	SPS6868
Q4541	151-0190-00			TRANSISTOR:NPN,SI,TO-92	04713	SPS7969
Q4600	151-0406-00	B060000	B062556	TRANSISTOR:SILICON,PNP	04713	ST1264
Q4600	----- -----			(1480C ONLY)		
Q4600	151-0406-01	B062557		TRANSISTOR:SILICON,PNP,SCREENED	80009	151-0406-01
Q4600	----- -----			(1480C ONLY)		

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
Q4600	151-0406-00	B060000	B067570	TRANSISTOR:SILICON,PNP	04713	ST1264
Q4600	----- -----			(1480R ONLY)		
Q4600	151-0406-01	B067571		TRANSISTOR:SILICON,PNP,SCREENED	80009	151-0406-01
Q4600	----- -----			(1480R ONLY)		
Q4601	151-0407-00	B060000	B073283	TRANSISTOR:SILICON,NPN	04713	SS2456
Q4601	----- -----			(1480C ONLY)		
Q4601	151-0407-02	B073284		TRANSISTOR:SS2456,SELECTED	04713	ORDER BY DESCR
Q4601	----- -----			(1480C ONLY)		
Q4601	151-0407-00	B060000	B079771	TRANSISTOR:SILICON,NPN	04713	SS2456
Q4601	----- -----			(1480R ONLY)		
Q4601	151-0407-02	B079772		TRANSISTOR:SS2456,SELECTED	04713	ORDER BY DESCR
Q4601	----- -----			(1480R ONLY)		
Q4710	151-0190-00			TRANSISTOR:NPN,SI,TO-92	04713	SPS7969
Q4719	151-0190-00			TRANSISTOR:NPN,SI,TO-92	04713	SPS7969
Q4720	151-0216-00			TRANSISTOR:SILICON,PNP	04713	SPS8803
Q4819	151-0190-00			TRANSISTOR:NPN,SI,TO-92	04713	SPS7969
Q4820	151-0410-00			TRANSISTOR:SILICON,PNP	04713	SPS6765
Q4832	151-0190-00			TRANSISTOR:NPN,SI,TO-92	04713	SPS7969
Q4910	151-0410-00			TRANSISTOR:SILICON,PNP	04713	SPS6765
Q4910	----- -----			(OPTION 07 ONLY)		
Q4911	151-0192-00			TRANSISTOR:SELECTED	04713	SPS8801
Q4911	----- -----			(OPTION 07 ONLY)		
Q4979	151-0190-00			TRANSISTOR:NPN,SI,TO-92	04713	SPS7969
Q6020	151-0406-00	B060000	B062556	TRANSISTOR:SILICON,PNP	04713	ST1264
Q6020	----- -----			(1480C ONLY)		
Q6020	151-0406-01	B062557		TRANSISTOR:SILICON,PNP,SCREENED	80009	151-0406-01
Q6020	----- -----			(1480C ONLY)		
Q6020	151-0406-00	B060000	B067570	TRANSISTOR:SILICON,PNP	04713	ST1264
Q6020	----- -----			(1480R ONLY)		
Q6020	151-0406-01	B067571		TRANSISTOR:SILICON,PNP,SCREENED	80009	151-0406-01
Q6020	----- -----			(1480R ONLY)		
Q6120	151-0406-00	B060000	B062556	TRANSISTOR:SILICON,PNP	04713	ST1264
Q6120	----- -----			(1480C ONLY)		
Q6120	151-0406-01	B062557		TRANSISTOR:SILICON,PNP,SCREENED	80009	151-0406-01
Q6120	----- -----			(1480C ONLY)		
Q6120	151-0406-00	B060000	B067570	TRANSISTOR:SILICON,PNP	04713	ST1264
Q6120	----- -----			(1480R ONLY)		
Q6120	151-0406-01	B067571		TRANSISTOR:SILICON,PNP,SCREENED	80009	151-0406-01
Q6120	----- -----			(1480R ONLY)		
Q6230	151-0407-00	B060000	B073283	TRANSISTOR:SILICON,NPN	04713	SS2456
Q6230	----- -----			(1480C ONLY)		
Q6230	151-0407-02	B073284		TRANSISTOR:SS2456,SELECTED	04713	ORDER BY DESCR
Q6230	----- -----			(1480C ONLY)		
Q6230	151-0407-00	B060000	B079771	TRANSISTOR:SILICON,NPN	04713	SS2456
Q6230	----- -----			(1480R ONLY)		
Q6230	151-0407-02	B079772		TRANSISTOR:SS2456,SELECTED	04713	ORDER BY DESCR
Q6230	----- -----			(1480R ONLY)		
Q6235	151-0406-00	B060000	B062556	TRANSISTOR:SILICON,PNP	04713	ST1264
Q6235	----- -----			(1480C ONLY)		
Q6235	151-0406-01	B062557		TRANSISTOR:SILICON,PNP,SCREENED	80009	151-0406-01
Q6235	----- -----			(1480C ONLY)		
Q6235	151-0406-00	B060000	B067570	TRANSISTOR:SILICON,PNP	04713	ST1264
Q6235	----- -----			(1480R ONLY)		
Q6235	151-0406-01	B067571		TRANSISTOR:SILICON,PNP,SCREENED	80009	151-0406-01
Q6235	----- -----			(1480R ONLY)		

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
Q6260	151-0232-00			TRANSISTOR:SILICON,NPN,DUAL	07263	SP12141
Q6322	151-0350-00	B060000	B062556	TRANSISTOR:SILICON,PNP	04713	SPS6700
Q6322	----- -----			(1480C ONLY)		
Q6322	151-0350-02	B062557		TRANSISTOR:SPS6700,SELECTED	80009	151-0350-02
Q6322	----- -----			(1480C ONLY)		
Q6322	151-0350-00	B060000	B067570	TRANSISTOR:SILICON,PNP	04713	SPS6700
Q6322	----- -----			(1480R ONLY)		
Q6322	151-0350-02	B067571		TRANSISTOR:SPS6700,SELECTED	80009	151-0350-02
Q6322	----- -----			(1480R ONLY)		
Q6326	151-0406-00	B060000	B062556	TRANSISTOR:SILICON,PNP	04713	ST1264
Q6326	----- -----			(1480C ONLY)		
Q6326	151-0406-01	B062557		TRANSISTOR:SILICON,PNP,SCREENED	80009	151-0406-01
Q6326	----- -----			(1480C ONLY)		
Q6326	151-0406-00	B060000	B067570	TRANSISTOR:SILICON,PNP	04713	ST1264
Q6326	----- -----			(1480R ONLY)		
Q6326	151-0406-01	B067571		TRANSISTOR:SILICON,PNP,SCREENED	80009	151-0406-01
Q6326	----- -----			(1480R ONLY)		
Q6560	151-0127-00			TRANSISTOR:SILICON,NPN	07263	S006075
Q6562	151-0133-00	B060000	B073283	TRANSISTOR:SILICON,PNP	80009	151-0133-00
Q6562	----- -----			(1480C ONLY)		
Q6562	151-0133-03	B073284		TRANSISTOR:2N3251,SCREENED	80009	151-0133-03
Q6562	----- -----			(1480C ONLY)		
Q6562	151-0133-00	B060000	B079771	TRANSISTOR:SILICON,PNP	80009	151-0133-00
Q6562	----- -----			(1480R ONLY)		
Q6562	151-0133-03	B079772		TRANSISTOR:2N3251,SCREENED	80009	151-0133-03
Q6562	----- -----			(1480R ONLY)		
Q6580	151-0407-00	B060000	B073283	TRANSISTOR:SILICON,NPN	04713	SS2456
Q6580	----- -----			(1480C ONLY)		
Q6580	151-0407-02	B073284		TRANSISTOR:SS2456,SELECTED	04713	ORDER BY DESCR
Q6580	----- -----			(1480C ONLY)		
Q6580	151-0407-00	B060000	B079771	TRANSISTOR:SILICON,NPN	04713	SS2456
Q6580	----- -----			(1480R ONLY)		
Q6580	151-0407-02	B079772		TRANSISTOR:SS2456,SELECTED	04713	ORDER BY DESCR
Q6580	----- -----			(1480R ONLY)		
Q6586	151-0188-00			TRANSISTOR:PNP,SI,TO-92	04713	SPS6868
Q6588	151-0406-00	B060000	B062556	TRANSISTOR:SILICON,PNP	04713	ST1264
Q6588	----- -----			(1480C ONLY)		
Q6588	151-0406-01	B062557		TRANSISTOR:SILICON,PNP,SCREENED	80009	151-0406-01
Q6588	----- -----			(1480C ONLY)		
Q6588	151-0406-00	B060000	B067570	TRANSISTOR:SILICON,PNP	04713	ST1264
Q6588	----- -----			(1480R ONLY)		
Q6588	151-0406-01	B067571		TRANSISTOR:SILICON,PNP,SCREENED	80009	151-0406-01
Q6588	----- -----			(1480R ONLY)		
Q6642	151-0302-00			TRANSISTOR:SILICON,NPN	07263	S038487
Q6644	151-0134-00			TRANSISTOR:SILICON,PNP	80009	151-0134-00
Q7100	151-0190-00			TRANSISTOR:NPN,SI,TO-92	04713	SPS7969
Q7100	----- -----			(OPTION 04 ONLY)		
Q7113	151-0190-00			TRANSISTOR:NPN,SI,TO-92	04713	SPS7969
Q7113	----- -----			(OPTION 04 ONLY)		
Q7183	151-0190-00			TRANSISTOR:NPN,SI,TO-92	04713	SPS7969
Q7183	----- -----			(OPTION 04 ONLY)		
Q8000	151-0192-00			TRANSISTOR:SELECTED	04713	SPS8801
Q8000	----- -----			(1482 ONLY)		

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
Q9180	151-0423-00	B060000	B062556	TRANSISTOR:SILICON,NPN	51984	NTC2333L
Q9180	----- -----			(1480C ONLY)		
Q9180	151-0423-02	B062557		TRANSISTOR:SILICON,NPN,SEL	000HM	2SC233K/T02
Q9180	----- -----			(1480C ONLY)		
Q9180	151-0423-00	B060000	B067570	TRANSISTOR:SILICON,NPN	51984	NTC2333L
Q9180	----- -----			(1480R ONLY)		
Q9180	151-0423-02	B067571		TRANSISTOR:SILICON,NPN,SEL	000HM	2SC233K/T02
Q9180	----- -----			(1480R ONLY)		
Q9200	151-0311-01	B060000	B073243	TRANSISTOR:SILICON,NPN	04713	SJE908
Q9200	----- -----			(1480C ONLY)		
Q9200	151-0311-02	B073244		TRANSISTOR:MJE340,SCREENED	80009	151-0311-02
Q9200	----- -----			(1480C ONLY)		
Q9200	151-0311-01	B060000	B079747	TRANSISTOR:SILICON,NPN	04713	SJE908
Q9200	----- -----			(1480R ONLY)		
Q9200	151-0311-02	B079748		TRANSISTOR:MJE340,SCREENED	80009	151-0311-02
Q9200	----- -----			(1480R ONLY)		
Q9300	151-0311-01	B060000	B073243	TRANSISTOR:SILICON,NPN	04713	SJE908
Q9300	----- -----			(1480C ONLY)		
Q9300	151-0311-02	B073244		TRANSISTOR:MJE340,SCREENED	80009	151-0311-02
Q9300	----- -----			(1480C ONLY)		
Q9300	151-0311-01	B060000	B079747	TRANSISTOR:SILICON,NPN	04713	SJE908
Q9300	----- -----			(1480R ONLY)		
Q9300	151-0311-02	B079748		TRANSISTOR:MJE340,SCREENED	80009	151-0311-02
Q9300	----- -----			(1480R ONLY)		
Q9405	151-0188-00			TRANSISTOR:PNP,SI,TO-92	04713	SPS6868
Q9405	----- -----			(OPTION 07 ONLY)		
Q9407	151-0188-00			TRANSISTOR:PNP,SI,TO-92	04713	SPS6868
Q9407	----- -----			(OPTION 07 ONLY)		
Q9410	151-0188-00			TRANSISTOR:PNP,SI,TO-92	04713	SPS6868
Q9410	----- -----			(OPTION 07 ONLY)		
Q9415	151-0188-00			TRANSISTOR:PNP,SI,TO-92	04713	SPS6868
Q9415	----- -----			(OPTION 07 ONLY)		
Q9423	151-0192-00			TRANSISTOR:SELECTED	04713	SPS8801
Q9423	----- -----			(OPTION 07 ONLY)		
Q9431	151-0188-00			TRANSISTOR:PNP,SI,TO-92	04713	SPS6868
Q9431	----- -----			(OPTION 07 ONLY)		
Q9433	151-0192-00			TRANSISTOR:SELECTED	04713	SPS8801
Q9433	----- -----			(OPTION 07 ONLY)		
Q9450	151-0192-00			TRANSISTOR:SELECTED	04713	SPS8801
Q9450	----- -----			(OPTION 07 ONLY)		
Q9458	151-0192-00			TRANSISTOR:SELECTED	04713	SPS8801
Q9458	----- -----			(OPTION 07 ONLY)		
Q9460	151-0192-00			TRANSISTOR:SELECTED	04713	SPS8801
Q9460	----- -----			(OPTION 07 ONLY)		
Q9500	151-0334-00	B060000	B062556	TRANSISTOR:SILICON,NPN	04713	SJE914
Q9500	----- -----			(1480C ONLY)		
Q9500	151-0334-01	B062557		TRANSISTOR:SJE914,SELECTED	80009	151-0334-01
Q9500	----- -----			(1480C ONLY)		
Q9500	151-0334-00	B060000	B067570	TRANSISTOR:SILICON,NPN	04713	SJE914
Q9500	----- -----			(1480R ONLY)		
Q9500	151-0334-01	B067571		TRANSISTOR:SJE914,SELECTED	80009	151-0334-01
Q9500	----- -----			(1480R ONLY)		

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
Q9600	151-0334-00	B060000	B062556	TRANSISTOR:SILICON,NPN	04713	SJE914
Q9600	----- -----			(1480C ONLY)		
Q9600	151-0334-01	B062557		TRANSISTOR:SJE914,SELECTED	80009	151-0334-01
Q9600	----- -----			(1480C ONLY)		
Q9600	151-0334-00	B060000	B067570	TRANSISTOR:SILICON,NPN	04713	SJE914
Q9600	----- -----			(1480R ONLY)		
Q9600	151-0334-01	B067571		TRANSISTOR:SJE914,SELECTED	80009	151-0334-01
Q9600	----- -----			(1480R ONLY)		
Q9700	151-0405-00	B060000	B073283	TRANSISTOR:SILICON,NPN,SEL FROM MJE800	04713	SJE943
Q9700	----- -----			(1480C ONLY)		
Q9700	151-0405-02	B073284		TRANSISTOR:SILICON,NPN,SCREENED	80009	151-0405-02
Q9700	----- -----			(1480C ONLY)		
Q9700	151-0405-00	B060000	B079771	TRANSISTOR:SILICON,NPN,SEL FROM MJE800	04713	SJE943
Q9700	----- -----			(1480R ONLY)		
Q9700	151-0405-02	B079772		TRANSISTOR:SILICON,NPN,SCREENED	80009	151-0405-02
Q9700	----- -----			(1480R ONLY)		
R1003	315-0220-00			RES.,FXD,CMPSN:22 OHM,5%,0.25W	57668	NTR25J-E 22E
R1005	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	57668	NTR25JE01K0
R1006	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	57668	NTR25J-E 15K
R1009	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	57668	NTR25J-E100K
R1022	312-0648-00			RES.,SET,MTCHD:15K OHM	91637	SPF-ARO
R1024	315-0475-00			RES.,FXD,CMPSN:4.7M OHM,5%,0.25W	01121	CB4755
R1027	321-0324-00			RES.,FXD,FILM:23.2K OHM,1%,0.125W	91637	MFF1816G23201F
R1031	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	57668	NTR25JE01K0
R1032	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	57668	NTR25JE01K0
R1033	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	57668	NTR25J-E100K
R1035	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	57668	NTR25J-E100K
R1039	321-0256-00			RES.,FXD,FILM:4.53K OHM,1%,0.125W	91637	MFF1816G45300F
R1040	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816G10001F
R1041	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816G10001F
R1045	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	57668	NTR25J-E100K
R1047	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	57668	NTR25J-E100K
R1049	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	57668	NTR25JE01K0
R1050	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	57668	NTR25JE01K0
R1053	321-0326-00			RES.,FXD,FILM:24.3K OHM,1%,0.125W	91637	CMF55116G24301F
R1054	321-0256-00			RES.,FXD,FILM:4.53K OHM,1%,0.125W	91637	MFF1816G45300F
R1055	315-0475-00			RES.,FXD,CMPSN:4.7M OHM,5%,0.25W	01121	CB4755
R1061	312-0648-00			RES.,SET,MTCHD:15K OHM	91637	SPF-ARO
R1062	315-0152-00			RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	57668	NTR25J-E01K5
R1064	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	57668	NTR25J-E 15K
R1065	321-0305-00			RES.,FXD,FILM:14.7K OHM,1%,0.125W	91637	MFF1816G14701F
R1070	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	57668	NTR25JE01K0
R1072	315-0220-00			RES.,FXD,CMPSN:22 OHM,5%,0.25W	57668	NTR25J-E 22E
R1075	315-0751-00			RES.,FXD,CMPSN:750 OHM,5%,0.25W	57668	NTR25J-E750E
R1076	315-0301-00			RES.,FXD,CMPSN:300 OHM,5%,0.25W	57668	NTR25J-E300E
R1092	321-0222-00			RES.,FXD,FILM:2K OHM,1%,0.125W	91637	MFF1816G20000F
R1095	321-0126-00			RES.,FXD,FILM:200 OHM,1%,0.125W	91637	CMF55116G200R0F
R1101	315-0562-00			RES.,FXD,CMPSN:5.6K OHM,5%,0.25W	57668	NTR25J-E05K6
R1102	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	57668	NTR25J-E47K0
R1103	315-0753-00			RES.,FXD,CMPSN:75K OHM,5%,0.25W	57668	NTR25J-E75K0
R1104	321-0265-00			RES.,FXD,FILM:5.62K OHM,1%,0.125W	24546	CT555621F
R1110	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	57668	NTR25J-E47E0
R1113	315-0562-00			RES.,FXD,CMPSN:5.6K OHM,5%,0.25W	57668	NTR25J-E05K6
R1122	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	57668	NTR25J-E100K

	Tektronix	Serial/Model No.			Mfr	
Ckt No.	Part No.	Eff	Dscont	Name & Description	Code	Mfr Part Number
R1124	321-0239-00			RES.,FXD,FILM:3.01K OHM,1%,0.125W	24546	CT55 3011 F
R1125	311-1225-00			RES.,VAR,NONWIR:1K OHM,20%,0.50W	32997	3386F-T04-102
R1126	321-0238-00			RES.,FXD,FILM:2.94K OHM,1%,0.125W	91637	MFF1816G29400F
R1131	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	57668	NTR25J-E04K7
R1132	315-0470-00	B060000	B079999	RES.,FXD,CMPSN:47 OHM,5%,0.25W	57668	NTR25J-E47E0
R1132	----- -----			(1480C ONLY)		
R1132	315-0241-00	B080000		RES.,FXD,CMPSN:240 OHM,5%,0.25W	57668	NTR25J-E 240E
R1132	----- -----			(1480C ONLY)		
R1132	315-0470-00	B060000	B089999	RES.,FXD,CMPSN:47 OHM,5%,0.25W	57668	NTR25J-E47E0
R1132	----- -----			(1480R ONLY)		
R1132	315-0241-00	B090000		RES.,FXD,CMPSN:240 OHM,5%,0.25W	57668	NTR25J-E 240E
R1132	----- -----			(1480R ONLY)		
R1133	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	57668	NTR25JE01K0
R1134	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	57668	NTR25J-E04K7
R1135	321-0324-00			RES.,FXD,FILM:23.2K OHM,1%,0.125W	91637	MFF1816G23201F
R1136	317-0331-00			RES.,FXD,CMPSN:330 OHM,5%,0.125W	01121	BB3315
R1136	----- -----			(END USAGE 670-3485-34 1480C/1480R ONLY)		
R1136	317-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.125W	01121	BB1005
R1136	----- -----			(BEGIN USAGE 670-3485-39 1480C/1480R ONLY)		
R1136	317-0331-00			RES.,FXD,CMPSN:330 OHM,5%,0.125W	01121	BB3315
R1136	----- -----			(END USAGE 670-3485-37 1481C/1481R		
R1136	----- -----			,1482C/1482R,1485C/1485R ONLY)		
R1136	317-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.125W	01121	BB1005
R1136	----- -----			(BEGIN USAGE 670-3485-42 1481C/R,1482C/R		
R1136	----- -----			,1485C/R ONLY)		
R1136	317-0331-00			RES.,FXD,CMPSN:330 OHM,5%,0.125W	01121	BB3315
R1136	----- -----			(END USAGE 670-3485-35 1480C,1482C		
R1136	----- -----			,1485C OPTION 04 ONLY)		
R1136	317-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.125W	01121	BB1005
R1136	----- -----			(BEGIN USAGE 670-3485-40 1480C,1482C		
R1136	----- -----			,1485C OPTION 04 ONLY)		
R1136	317-0331-00			RES.,FXD,CMPSN:330 OHM,5%,0.125W	01121	BB3315
R1136	----- -----			(END USAGE 670-3485-38 1481C,1485C		
R1136	----- -----			OPTION 04 ONLY)		
R1136	317-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.125W	01121	BB1005
R1136	----- -----			(BEGIN USAGE 670-3485-43 1481C,1485C		
R1136	----- -----			OPTION 04 ONLY)		
R1137	317-0331-00			RES.,FXD,CMPSN:330 OHM,5%,0.125W	01121	BB3315
R1137	----- -----			(END USAGE 670-3485-34 1480C/1480R ONLY)		
R1137	317-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.125W	01121	BB1005
R1137	----- -----			(BEGIN USAGE 670-3485-39 1480C/1480R ONLY)		
R1137	317-0331-00			RES.,FXD,CMPSN:330 OHM,5%,0.125W	01121	BB3315
R1137	----- -----			(END USAGE 670-3485-37 1481C/1481R		
R1137	----- -----			,1482C/1482R,1485C/1485R ONLY)		
R1137	317-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.125W	01121	BB1005
R1137	----- -----			(BEGIN USAGE 670-3485-42 1481C/R,1482C/R		
R1137	----- -----			,1485C/R ONLY)		
R1137	317-0331-00			RES.,FXD,CMPSN:330 OHM,5%,0.125W	01121	BB3315
R1137	----- -----			(END USAGE 670-3485-35 1480C,1482C		
R1137	----- -----			,1485C OPTION 04 ONLY)		
R1137	317-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.125W	01121	BB1005
R1137	----- -----			(BEGIN USAGE 670-3485-40 1480C,1482C		
R1137	----- -----			,1485C OPTION 04 ONLY)		

	Tektronix	Serial/Model No.			Mfr	
Ckt No.	Part No.	Eff	Dscont	Name & Description	Code	Mfr Part Number
R1137	317-0331-00			RES.,FXD,CMPSN:330 OHM,5%,0.125W	01121	BB3315
R1137	----- -----			(END USAGE 670-3485-38 1481C,1485C		
R1137	----- -----			OPTION 04 ONLY)		
R1137	317-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.125W	01121	BB1005
R1137	----- -----			(BEGIN USAGE 670-3485-43 1481C,1485C		
R1137	----- -----			OPTION 04 ONLY)		
R1141	317-0331-00			RES.,FXD,CMPSN:330 OHM,5%,0.125W	01121	BB3315
R1141	----- -----			(END USAGE 670-3485-34 1480C/1480R ONLY)		
R1141	317-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.125W	01121	BB1005
R1141	----- -----			(BEGIN USAGE 670-3485-39 1480C/1480R ONLY)		
R1141	317-0331-00			RES.,FXD,CMPSN:330 OHM,5%,0.125W	01121	BB3315
R1141	----- -----			(END USAGE 670-3485-37 1481C/1481R		
R1141	----- -----			.1482C/1482R,1485C/1485R ONLY)		
R1141	317-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.125W	01121	BB1005
R1141	----- -----			(BEGIN USAGE 670-3485-42 1481C/R,1482C/R		
R1141	----- -----			.1485C/R ONLY)		
R1141	317-0331-00			RES.,FXD,CMPSN:330 OHM,5%,0.125W	01121	BB3315
R1141	----- -----			(END USAGE 670-3485-35 1480C,1482C		
R1141	----- -----			,1485C OPTION 04 ONLY)		
R1141	317-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.125W	01121	BB1005
R1141	----- -----			(BEGIN USAGE 670-3485-40 1480C,1482C		
R1141	----- -----			,1485C OPTION 04 ONLY)		
R1141	317-0331-00			RES.,FXD,CMPSN:330 OHM,5%,0.125W	01121	BB3315
R1141	----- -----			(END USAGE 670-3485-38 1481C,1485C		
R1141	----- -----			OPTION 04 ONLY)		
R1141	317-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.125W	01121	BB1005
R1141	----- -----			(BEGIN USAGE 670-3485-43 1481C,1485C		
R1141	----- -----			OPTION 04 ONLY)		
R1142	317-0331-00			RES.,FXD,CMPSN:330 OHM,5%,0.125W	01121	BB3315
R1142	----- -----			(END USAGE 670-3485-34 1480C/1480R ONLY)		
R1142	317-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.125W	01121	BB1005
R1142	----- -----			(BEGIN USAGE 670-3485-39 1480C/1480R ONLY)		
R1142	317-0331-00			RES.,FXD,CMPSN:330 OHM,5%,0.125W	01121	BB3315
R1142	----- -----			(END USAGE 670-3485-37 1481C/1481R		
R1142	----- -----			.1482C/1482R,1485C/1485R ONLY)		
R1142	317-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.125W	01121	BB1005
R1142	----- -----			(BEGIN USAGE 670-3485-42 1481C/R,1482C/R		
R1142	----- -----			.1485C/R ONLY)		
R1142	317-0331-00			RES.,FXD,CMPSN:330 OHM,5%,0.125W	01121	BB3315
R1142	----- -----			(END USAGE 670-3485-35 1480C,1482C		
R1142	----- -----			,1485C OPTION 04 ONLY)		
R1142	317-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.125W	01121	BB1005
R1142	----- -----			(BEGIN USAGE 670-3485-40 1480C,1482C		
R1142	----- -----			,1485C OPTION 04 ONLY)		
R1142	317-0331-00			RES.,FXD,CMPSN:330 OHM,5%,0.125W	01121	BB3315
R1142	----- -----			(END USAGE 670-3485-38 1481C,1485C		
R1142	----- -----			OPTION 04 ONLY)		
R1142	317-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.125W	01121	BB1005
R1142	----- -----			(BEGIN USAGE 670-3485-43 1481C,1485C		
R1142	----- -----			OPTION 04 ONLY)		
R1143	321-0265-00			RES.,FXD,FILM:5.62K OHM,1%,0.125W	24546	CT555621F
R1146	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	57668	NTR25JE01K0
R1151	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	57668	NTR25J-E100K
R1152	315-0562-00			RES.,FXD,CMPSN:5.6K OHM,5%,0.25W	57668	NTR25J-E05K6

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R1153	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	57668	NTR25J-E47K0
R1156	315-0220-00			RES.,FXD,CMPSN:22 OHM,5%,0.25W	57668	NTR25J-E 22E
R1164	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	57668	NTR25J-E 100E
R1167	315-0151-00			RES.,FXD,CMPSN:150 OHM,5%,0.25W	57668	NTR25J-E150E
R1172	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	57668	NTR25J-E47E0
R1172	----- -----			(1480, 1482 ONLY)		
R1192	321-0222-00			RES.,FXD,FILM:2K OHM,1%,0.125W	91637	MFF1816G20000F
R1201	315-0562-00			RES.,FXD,CMPSN:5.6K OHM,5%,0.25W	57668	NTR25J-E05K6
R1202	315-0333-00			RES.,FXD,CMPSN:33K OHM,5%,0.25W	57668	NTR25J-E33K0
R1203	315-0513-00			RES.,FXD,CMPSN:51K OHM,5%,0.25W	57668	NTR25J-E51K0
R1219	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	57668	NTR25J-E100K
R1226	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	57668	NTR25J-E100K
R1231	315-0330-00			RES.,FXD,CMPSN:33 OHM,5%,0.25W	57668	NTR25J-E 33E
R1233	311-1224-00			RES.,VAR,NONWIR:500 OHM,20%,0.50W	32997	3386F-T04-501
R1235	321-0258-00			RES.,FXD,FILM:4.75K OHM,1%,0.125W	91637	MFF1816G47500F
R1245	315-0330-00			RES.,FXD,CMPSN:33 OHM,5%,0.25W	57668	NTR25J-E 33E
R1251	321-0260-00			RES.,FXD,FILM:4.99K OHM,1%,0.125W	91637	MFF1816G49900F
R1254	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	57668	NTR25J-E100K
R1255	315-0753-00			RES.,FXD,CMPSN:75K OHM,5%,0.25W	57668	NTR25J-E75K0
R1256	315-0911-00			RES.,FXD,CMPSN:910 OHM,5%,0.25W	57668	NTR25J-E910E
R1262	315-0911-00			RES.,FXD,CMPSN:910 OHM,5%,0.25W	57668	NTR25J-E910E
R1263	315-0911-00			RES.,FXD,CMPSN:910 OHM,5%,0.25W	57668	NTR25J-E910E
R1264	315-0562-00			RES.,FXD,CMPSN:5.6K OHM,5%,0.25W	57668	NTR25J-E05K6
R1265	315-0911-00			RES.,FXD,CMPSN:910 OHM,5%,0.25W	57668	NTR25J-E910E
R1271	315-0911-00			RES.,FXD,CMPSN:910 OHM,5%,0.25W	57668	NTR25J-E910E
R1273	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	57668	NTR25J-E100K
R1274	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	57668	NTR25J-E47E0
R1285	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	57668	NTR25J-E 10E0
R1291	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	57668	NTR25J-E 100E
R1296	321-0164-00			RES.,FXD,FILM:499 OHM,1%,0.125W	91637	CMF55116G499R0F
R1304	315-0821-00			RES.,FXD,CMPSN:820 OHM,5%,0.25W	57668	NTR25J-E 820E
R1305	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	57668	NTR25J-E 15K
R1307	321-0364-03			RES.,FXD,FILM:60.4K OHM,0.25%,0.125W	91637	MFF1816D60401C
R1327	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	57668	NTR25JE01K0
R1329	321-0326-00			RES.,FXD,FILM:24.3K OHM,1%,0.125W	91637	CMF55116G24301F
R1330	321-0101-00			RES.,FXD,FILM:110 OHM,1%,0.125W	91637	CMF55116G110R0F
R1331	315-0683-00	B080000		RES.,FXD,CMPSN:68K OHM,5%,0.25W	57668	NTR25J-E68K0
R1331	----- -----			(1480C ONLY)		
R1331	315-0683-00	B090000		RES.,FXD,CMPSN:68K OHM,5%,0.25W	57668	NTR25J-E68K0
R1331	----- -----			(1480R ONLY)		
R1332	315-0682-00			RES.,FXD,CMPSN:6.8K OHM,5%,0.25W	57668	NTR25J-E06K8
R1333	315-0392-00	B060000	B062198	RES.,FXD,CMPSN:3.9K OHM,5%,0.25W	57668	NTR25J-E03K9
R1333	----- -----			(1480C ONLY)		
R1333	315-0472-00	B062199		RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	57668	NTR25J-E04K7
R1333	----- -----			(1480C ONLY)		
R1333	315-0392-00	B060000	B065886	RES.,FXD,CMPSN:3.9K OHM,5%,0.25W	57668	NTR25J-E03K9
R1333	----- -----			(1480R ONLY)		
R1333	315-0472-00	B065887		RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	57668	NTR25J-E04K7
R1333	----- -----			(1480R ONLY)		
R1334	315-0511-00			RES.,FXD,CMPSN:510 OHM,5%,0.25W	57668	NTR25J-E 510E
R1335	307-0124-00			RES.,THERMAL:5K OHM,10%	50157	1D1618
R1337	315-0562-00			RES.,FXD,CMPSN:5.6K OHM,5%,0.25W	57668	NTR25J-E05K6
R1338	315-0154-00	B080000		RES.,FXD,CMPSN:150K OHM,5%,0.25W	57668	NTR25J-E150K
R1338	----- -----			(1480C ONLY)		

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Ckt No.	Part No.	Eff	Dscont	Name & Description	Code	Mfr Part Number
R1338	315-0154-00	B090000		RES.,FXD,CMPSN:150K OHM,5%,0.25W	57668	NTR25J-E150K
R1338	----- -----			(1480R ONLY)		
R1339	321-0101-00			RES.,FXD,FILM:110 OHM,1%,0.125W	91637	CMF55116G110R0F
R1341	315-0511-00			RES.,FXD,CMPSN:510 OHM,5%,0.25W	57668	NTR25J-E 510E
R1344	321-0222-00			RES.,FXD,FILM:2K OHM,1%,0.125W	91637	MFF1816G20000F
R1345	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	57668	NTR25JE01K0
R1348	311-1228-00			RES.,VAR,NONWIR:10K OHM,20%,0.50W	32997	3386F-T04-103
R1349	315-0821-00			RES.,FXD,CMPSN:820 OHM,5%,0.25W	57668	NTR25J-E 820E
R1352	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	57668	NTR25J-E10K0
R1354	315-0821-00			RES.,FXD,CMPSN:820 OHM,5%,0.25W	57668	NTR25J-E 820E
R1361	315-0911-00			RES.,FXD,CMPSN:910 OHM,5%,0.25W	57668	NTR25J-E910E
R1362	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	57668	NTR25JE01K0
R1363	315-0911-00			RES.,FXD,CMPSN:910 OHM,5%,0.25W	57668	NTR25J-E910E
R1365	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	57668	NTR25JE01K0
R1366	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	57668	NTR25JE01K0
R1367	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	57668	NTR25JE01K0
R1398	321-0164-00			RES.,FXD,FILM:499 OHM,1%,0.125W	91637	CMF55116G499R0F
R1405	315-0432-00			RES.,FXD,CMPSN:4.3K OHM,5%,0.25W	57668	NTR25J-E04K3
R1408	321-0272-00			RES.,FXD,FILM:6.65K OHM,1%,0.125W	91637	MFF1816G66500F
R1411	321-0263-00			RES.,FXD,FILM:5.36K OHM,1%,0.125W	91637	MFF1816G53600F
R1412	321-0085-00			RES.,FXD,FILM:75 OHM,1%,0.125W	91637	CMF55116G75R00F
R1415	321-0085-00			RES.,FXD,FILM:75 OHM,1%,0.125W	91637	CMF55116G75R00F
R1422	321-0176-00			RES.,FXD,FILM:665 OHM,1%,0.125W	91637	CMF55116G665R0F
R1425	315-0182-00			RES.,FXD,CMPSN:1.8K OHM,5%,0.25W	57668	NTR25J-E1K8
R1427	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	57668	NTR25JE01K0
R1429	321-0164-00			RES.,FXD,FILM:499 OHM,1%,0.125W	91637	CMF55116G499R0F
R1432	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	57668	NTR25J-E 100E
R1438	321-0261-00			RES.,FXD,FILM:5.11K OHM,1%,0.125W	91637	MFF1816G51100F
R1439	315-0512-00			RES.,FXD,CMPSN:5.1K OHM,5%,0.25W	57668	NTR25J-E05K1
R1441	321-0230-00			RES.,FXD,FILM:2.43K OHM,1%,0.125W	24546	CT552431F
R1442	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	57668	NTR25J-E 100E
R1443	315-0470-00	B060000	B079999	RES.,FXD,CMPSN:47 OHM,5%,0.25W	57668	NTR25J-E47E0
R1443	----- -----			(1480C ONLY)		
R1443	315-0241-00	B080000		RES.,FXD,CMPSN:240 OHM,5%,0.25W	57668	NTR25J-E 240E
R1443	----- -----			(1480C ONLY)		
R1443	315-0470-00	B060000	B089999	RES.,FXD,CMPSN:47 OHM,5%,0.25W	57668	NTR25J-E47E0
R1443	----- -----			(1480R ONLY)		
R1443	315-0241-00	B090000		RES.,FXD,CMPSN:240 OHM,5%,0.25W	57668	NTR25J-E 240E
R1443	----- -----			(1480R ONLY)		
R1453	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	57668	NTR25J-E47E0
R1476	315-0511-00	B070000		RES.,FXD,CMPSN:510 OHM,5%,0.25W	57668	NTR25J-E 510E
R1477	315-0102-00	B060000	B069999	RES.,FXD,CMPSN:1K OHM,5%,0.25W	57668	NTR25JE01K0
R1477	315-0391-00	B070000		RES.,FXD,CMPSN:390 OHM,5%,0.25W	57668	NTR25J-E390E
R1478	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	57668	NTR25J-E10K0
R1479	321-0239-00			RES.,FXD,FILM:3.01K OHM,1%,0.125W	24546	CT55 3011 F
R1481	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	57668	NTR25J-E04K7
R1482	321-0246-00			RES.,FXD,FILM:3.57K OHM,1%,0.125W	91637	CMF55116G35700F
R1487	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	57668	NTR25J-E10K0
R1488	315-0680-00	B060000	B079999	RES.,FXD,CMPSN:68 OHM,5%,0.25W	57668	NTR25J-E68E0
R1488	----- -----			(1480C ONLY)		
R1488	315-0120-00	B080000		RES.,FXD,CMPSN:12 OHM,5%,0.25W	57668	NTR25J-R12
R1488	----- -----			(1480C ONLY)		

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
R1488	315-0680-00	B060000	B089999	RES.,FXD,CMPSN:68 OHM,5%,0.25W	57668	NTR25J-E68E0
R1488	----- -----			(1480R ONLY)		
R1488	315-0120-00	B090000		RES.,FXD,CMPSN:12 OHM,5%,0.25W	57668	NTR25J-R12
R1488	----- -----			(1480R ONLY)		
R1491	321-0176-00			RES.,FXD,FILM:665 OHM,1%,0.125W	91637	CMF55116G665R0F
R1493	321-0168-00			RES.,FXD,FILM:549 OHM,1%,0.125W	91637	CMF55116G549R0F
R1494	315-0242-00			RES.,FXD,CMPSN:2.4K OHM,5%,0.25W	57668	NTR25J-E02K4
R1495	315-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.25W	57668	NTR25J-E 22K
R1502	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	57668	NTR25J-E100K
R1504	315-0152-00			RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	57668	NTR25J-E01K5
R1517	321-0176-00			RES.,FXD,FILM:665 OHM,1%,0.125W	91637	CMF55116G665R0F
R1521	303-0471-00			RES.,FXD,CMPSN:470 OHM,5%,1W	01121	GB4715
R1524	315-0131-00			RES.,FXD,CMPSN:130 OHM,5%,0.25W	57668	NTR25J-E 130E
R1525	311-1267-00			RES.,VAR,NONWIR:5K OHM,10%,0.50W	32997	3329P-L58-502
R1527	315-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.25W	57668	NTR25J-E02K0
R1533	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	57668	NTR25J-E 100E
R1537	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	57668	NTR25J-E 100E
R1539	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	57668	NTR25J-E 100E
R1543	315-0822-00			RES.,FXD,CMPSN:8.2K OHM,5%,0.25W	57668	NTR25J-E 8K2
R1545	315-0362-00			RES.,FXD,CMPSN:3.6K OHM,5%,0.25W	57668	NTR25J-E 3K6
R1547	315-0683-00			RES.,FXD,CMPSN:68K OHM,5%,0.25W	57668	NTR25J-E68K0
R1549	315-0822-00			RES.,FXD,CMPSN:8.2K OHM,5%,0.25W	57668	NTR25J-E 8K2
R1551	315-0682-00			RES.,FXD,CMPSN:6.8K OHM,5%,0.25W	57668	NTR25J-E06K8
R1552	315-0333-00			RES.,FXD,CMPSN:33K OHM,5%,0.25W	57668	NTR25J-E33K0
R1555	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	57668	NTR25J-E 15K
R1557	315-0472-00	B060000	B069999	RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	57668	NTR25J-E04K7
R1557	315-0332-00	B070000		RES.,FXD,CMPSN:3.3K OHM,5%,0.25W	57668	NTR25J-E03K3
R1558	315-0432-00	B070000		RES.,FXD,CMPSN:4.3K OHM,5%,0.25W	57668	NTR25J-E04K3
R1568	315-0393-00			RES.,FXD,CMPSN:39K OHM,5%,0.25W	57668	NTR25J-E39K0
R1569	315-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.25W	57668	NTR25J-E02K0
R1571	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	57668	NTR25J-E47E0
R1574	321-0229-00			RES.,FXD,FILM:2.37K OHM,1%,0.125W	24546	CT552371F
R1575	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	57668	NTR25J-E47E0
R1577	315-0332-00	B060000	B069999	RES.,FXD,CMPSN:3.3K OHM,5%,0.25W	57668	NTR25J-E03K3
R1577	315-0242-00	B070000		RES.,FXD,CMPSN:2.4K OHM,5%,0.25W	57668	NTR25J-E02K4
R1581	315-0124-00			RES.,FXD,CMPSN:120K OHM,5%,0.25W	57668	NTR25J-E 120K
R1582	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	57668	NTR25J-E 100E
R1584	315-0472-00	B060000	B069999	RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	57668	NTR25J-E04K7
R1584	315-0162-00	B070000		RES.,FXD,CMPSN:1.6K OHM,5%,0.25W	57668	NTR25J-E 1K6
R1585	321-0066-00			RES.,FXD,FILM:47.5 OHM,1%,0.125W	91637	MFF1816G47R50F
R1586	301-0751-00			RES.,FXD,CMPSN:750 OHM,5%,0.50W	57668	TR50J-E750E
R1587	321-0176-00	B060000	B062198	RES.,FXD,FILM:665 OHM,1%,0.125W	91637	CMF55116G665R0F
R1587	----- -----			(1480C ONLY)		
R1587	321-0179-00	B062199		RES.,FXD,FILM:715 OHM,1%,0.125W	91637	CMF55116G715R0F
R1587	----- -----			(1480C ONLY)		
R1587	321-0176-00	B060000	B065886	RES.,FXD,FILM:665 OHM,1%,0.125W	91637	CMF55116G665R0F
R1587	----- -----			(1480R ONLY)		
R1587	321-0179-00	B065887		RES.,FXD,FILM:715 OHM,1%,0.125W	91637	CMF55116G715R0F
R1587	----- -----			(1480R ONLY)		
R1588	315-0562-00	B062199		RES.,FXD,CMPSN:5.6K OHM,5%,0.25W	57668	NTR25J-E05K6
R1588	----- -----			(1480C ONLY)		
R1588	315-0562-00	B065887		RES.,FXD,CMPSN:5.6K OHM,5%,0.25W	57668	NTR25J-E05K6
R1588	----- -----			(1480R ONLY)		

	Tektronix	Serial/Model No.			Mfr	
Ckt No.	Part No.	Eff	Dscont	Name & Description	Code	Mfr Part Number
R1589	307-0124-00	B062199		RES.,THERMAL:5K OHM,10%	50157	1D1618
R1589	----- -----			(1480C ONLY)		
R1589	307-0124-00	B065887		RES.,THERMAL:5K OHM,10%	50157	1D1618
R1589	----- -----			(1480R ONLY)		
R1590	315-0124-00	B080000		RES.,FXD,CMPSN:120K OHM,5%,0.25W	57668	NTR25J-E 120K
R1590	----- -----			(1480C ONLY)		
R1590	315-0124-00	B090000		RES.,FXD,CMPSN:120K OHM,5%,0.25W	57668	NTR25J-E 120K
R1590	----- -----			(1480R ONLY)		
R1591	321-0091-00			RES.,FXD,FILM:86.6 OHM,1%,0.125W	91637	CMF55116G86R60F
R1592	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	57668	NTR25J-E04K7
R1595	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	57668	NTR25J-E10K0
R1597	321-0236-00			RES.,FXD,FILM:2.8K OHM,1%,0.125W	91637	MFF1816G28000F
R1607	307-1033-00			RES.,FXD,FILM:1.2K OHM,1%,3W	19647	MS245N-D12000F
R1609	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	57668	NTR25J-E 10E0
R1625	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	57668	NTR25J-E 15K
R1626	311-1565-00	B080000		RES.,VAR,NONWIR:250 OHM,20%,0.50W	73138	91-87-0
R1626	----- -----			(1480C ONLY)		
R1626	311-1565-00	B090000		RES.,VAR,NONWIR:250 OHM,20%,0.50W	73138	91-87-0
R1626	----- -----			(1480R ONLY)		
R1627	321-0114-00			RES.,FXD,FILM:150 OHM,1%,0.125W	91637	CMF55116G150R0F
R1628	315-0391-00			RES.,FXD,CMPSN:390 OHM,5%,0.25W	57668	NTR25J-E390E
R1634	321-0059-00			RES.,FXD,FILM:40.2 OHM,1%,0.125W	91637	CMF55116G50R20F
R1635	323-0208-00			RES.,FXD,FILM:1.43K OHM,1%,0.50W	75042	CECT0-1431F
R1645	301-0122-00			RES.,FXD,CMPSN:1.2K OHM,5%,0.5W	01121	EB1225
R1647	321-0169-00			RES.,FXD,FILM:562 OHM,1%,0.125W	91637	CMF55116G562R0F
R1655	321-0143-00			RES.,FXD,FILM:301 OHM,1%,0.125W	91637	CMF55116G301R0F
R1656	321-0126-00			RES.,FXD,FILM:200 OHM,1%,0.125W	91637	CMF55116G200R0F
R1658	315-0271-00	B080000		RES.,FXD,CMPSN:270 OHM,5%,0.25W	01121	CB2715
R1658	----- -----			(1480C ONLY)		
R1658	315-0271-00	B090000		RES.,FXD,CMPSN:270 OHM,5%,0.25W	01121	CB2715
R1658	----- -----			(1480R ONLY)		
R1660	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	57668	NTR25J-E 10E0
R1662	315-0271-00	B080000		RES.,FXD,CMPSN:270 OHM,5%,0.25W	01121	CB2715
R1662	----- -----			(1480C ONLY)		
R1662	315-0271-00	B090000		RES.,FXD,CMPSN:270 OHM,5%,0.25W	01121	CB2715
R1662	----- -----			(1480R ONLY)		
R1664	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	57668	NTR25J-E 10E0
R1666	311-1232-00			RES.,VAR,NONWIR:50K OHM,20%,0.50W	32997	3386F-T04-503
R1675	315-0100-00	B060000	B073693	RES.,FXD,CMPSN:10 OHM,5%,0.25W	57668	NTR25J-E 10E0
R1675	----- -----			(1480C ONLY)		
R1675	315-0101-00	B073694		RES.,FXD,CMPSN:100 OHM,5%,0.25W	57668	NTR25J-E 100E
R1675	----- -----			(1480C ONLY)		
R1675	315-0100-00	B060000	B081953	RES.,FXD,CMPSN:10 OHM,5%,0.25W	57668	NTR25J-E 10E0
R1675	----- -----			(1480R ONLY)		
R1675	315-0101-00	B081954		RES.,FXD,CMPSN:100 OHM,5%,0.25W	57668	NTR25J-E 100E
R1675	----- -----			(1480R ONLY)		
R1681	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	57668	NTR25J-E 100E
R1684	321-0114-00			RES.,FXD,FILM:150 OHM,1%,0.125W	91637	CMF55116G150R0F
R1685	315-0272-00			RES.,FXD,CMPSN:2.7K OHM,5%,0.25W	57668	NTR25J-E02K7
R1688	315-0362-00			RES.,FXD,CMPSN:3.6K OHM,5%,0.25W	57668	NTR25J-E 3K6
R1693	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	57668	NTR25J-E47E0
R1695	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	57668	NTR25J-E100K
R1713	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	57668	NTR25J-E04K7
R1715	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	57668	NTR25J-E47E0

	Tektronix	Serial/Model No.			Mfr	
Ckt No.	Part No.	Eff	Dscont	Name & Description	Code	Mfr Part Number
R1717	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	57668	NTR25J-E47E0
R1724	323-0158-00			RES.,FXD,FILM:432 OHM,1%,0.50W	75042	CECT0-4320F
R1725	323-0158-00			RES.,FXD,FILM:432 OHM,1%,0.50W	75042	CECT0-4320F
R1727	321-0097-00			RES.,FXD,FILM:100 OHM,1%,0.125W	91637	CMF55116G100R0F
R1734	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	57668	NTR25J-E 15K
R1735	321-0114-00			RES.,FXD,FILM:150 OHM,1%,0.125W	91637	CMF55116G150R0F
R1738	315-0391-00			RES.,FXD,CMPSN:390 OHM,5%,0.25W	57668	NTR25J-E390E
R1739	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	57668	NTR25J-E 15K
R1745	321-0059-00			RES.,FXD,FILM:40.2 OHM,1%,0.125W	91637	CMF55116G50R20F
R1749	301-0122-00			RES.,FXD,CMPSN:1.2K OHM,5%,0.5W	01121	EB1225
R1751	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	57668	NTR25J-E 100E
R1752	321-0169-00			RES.,FXD,FILM:562 OHM,1%,0.125W	91637	CMF55116G562R0F
R1755	321-0143-00			RES.,FXD,FILM:301 OHM,1%,0.125W	91637	CMF55116G301R0F
R1761	321-0138-00			RES.,FXD,FILM:267 OHM,1%,0.125W	91637	CMF55116G267R0F
R1762	321-0126-00			RES.,FXD,FILM:200 OHM,1%,0.125W	91637	CMF55116G200R0F
R1768	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	57668	NTR25JE01K0
R1769	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	57668	NTR25JE01K0
R1779	321-0117-00			RES.,FXD,FILM:162 OHM,1%,0.125W	91637	CMF55116G162R0F
R1781	315-0151-00			RES.,FXD,CMPSN:150 OHM,5%,0.25W	57668	NTR25J-E150E
R1786	315-0271-00			RES.,FXD,CMPSN:270 OHM,5%,0.25W	01121	CB2715
R1787	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	57668	NTR25J-E47E0
R1789	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	57668	NTR25JE01K0
R1797	315-0823-00			RES.,FXD,CMPSN:82K OHM,5%,0.25W	57668	NTR25J-E82K
R1806	315-0752-00			RES.,FXD,CMPSN:7.5K OHM,5%,0.25W	57668	NTR25J-E07K5
R1807	307-1033-00			RES.,FXD,FILM:1.2K OHM,1%,3W	19647	MS245N-D12000F
R1808	315-0753-00			RES.,FXD,CMPSN:75K OHM,5%,0.25W	57668	NTR25J-E75K0
R1809	315-0624-00			RES.,FXD,CMPSN:620K OHM,5%,0.25W	57668	NTR25J-E 620K
R1810	315-0914-00			RES.,FXD,CMPSN:910K OHM,5%,0.25W	57668	NTR25J-E 910K
R1812	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	57668	NTR25J-E10K0
R1814	311-1228-00			RES.,VAR,NONWIR:10K OHM,20%,0.50W	32997	3386F-T04-103
R1815	315-0822-00			RES.,FXD,CMPSN:8.2K OHM,5%,0.25W	57668	NTR25J-E 8K2
R1825	315-0753-00			RES.,FXD,CMPSN:75K OHM,5%,0.25W	57668	NTR25J-E75K0
R1827	311-1225-00			RES.,VAR,NONWIR:1K OHM,20%,0.50W	32997	3386F-T04-102
R1830	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	57668	NTR25JE01K0
R1844	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	57668	NTR25J-E 100E
R1848	321-0147-00			RES.,FXD,FILM:332 OHM,1%,0.125W	91637	CMF55116G332R0F
R1849	321-0123-00			RES.,FXD,FILM:187 OHM,1%,0.125W	91637	CMF55116G187R0F
R1851	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	57668	NTR25JE01K0
R1851	----- -----			(END USAGE 670-3485-34 1480C/1480R ONLY)		
R1851	315-0331-00			RES.,FXD,CMPSN:330 OHM,5%,0.25W	57668	NTR25J-E330E
R1851	----- -----			(BEGIN USAGE 670-3485-39 1480C/1480R ONLY)		
R1851	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	57668	NTR25JE01K0
R1851	----- -----			(END USAGE 670-3485-37 1481C/1481R		
R1851	----- -----			,1482C/1482R,1485C/1485R ONLY)		
R1851	315-0331-00			RES.,FXD,CMPSN:330 OHM,5%,0.25W	57668	NTR25J-E330E
R1851	----- -----			(BEGIN USAGE 670-3485-42 1481C/R,1482C/R		
R1851	----- -----			,1485C/R ONLY)		
R1851	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	57668	NTR25JE01K0
R1851	----- -----			(END USAGE 670-3485-35 1480C,1482C		
R1851	----- -----			,1485C OPTION 04 ONLY)		
R1851	315-0331-00			RES.,FXD,CMPSN:330 OHM,5%,0.25W	57668	NTR25J-E330E
R1851	----- -----			(BEGIN USAGE 670-3485-40 1480C,1482C		
R1851	----- -----			,1485C OPTION 04 ONLY)		

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R1851	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	57668	NTR25JE01K0
R1851	----- -----			(END USAGE 670-3485-38 1481C,1485C		
R1851	----- -----			OPTION 04 ONLY)		
R1851	315-0331-00			RES.,FXD,CMPSN:330 OHM,5%,0.25W	57668	NTR25J-E330E
R1851	----- -----			(BEGIN USAGE 670-3485-43 1481C,1485C		
R1851	----- -----			OPTION 04 ONLY)		
R1855	321-0286-00			RES.,FXD,FILM:9.31K OHM,1%,0.125W	91637	MFF1816G93100F
R1857	315-0104-00	B060000	B079999	RES.,FXD,CMPSN:100K OHM,5%,0.25W	57668	NTR25J-E100K
R1857	----- -----			(1480C ONLY)		
R1857	315-0124-00	B080000		RES.,FXD,CMPSN:120K OHM,5%,0.25W	57668	NTR25J-E 120K
R1857	----- -----			(1480C ONLY)		
R1857	315-0104-00	B060000	B089999	RES.,FXD,CMPSN:100K OHM,5%,0.25W	57668	NTR25J-E100K
R1857	----- -----			(1480R ONLY)		
R1857	315-0124-00	B090000		RES.,FXD,CMPSN:120K OHM,5%,0.25W	57668	NTR25J-E 120K
R1857	----- -----			(1480R ONLY)		
R1859	321-0123-00			RES.,FXD,FILM:187 OHM,1%,0.125W	91637	CMF55116G187R0F
R1863	321-0163-00			RES.,FXD,FILM:487 OHM,1%,0.125W	91637	CMF55116G487R0F
R1864	315-0681-00			RES.,FXD,CMPSN:680 OHM,5%,0.25W	57668	NTR25J-E680E
R1867	321-0286-00			RES.,FXD,FILM:9.31K OHM,1%,0.125W	91637	MFF1816G93100F
R1868	321-0163-00			RES.,FXD,FILM:487 OHM,1%,0.125W	91637	CMF55116G487R0F
R1869	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	57668	NTR25J-E 100E
R1870	321-0286-00			RES.,FXD,FILM:9.31K OHM,1%,0.125W	91637	MFF1816G93100F
R1871	321-0193-00			RES.,FXD,FILM:1K OHM,1%,0.125W	19701	5043ED1K00F
R1876	321-0193-00			RES.,FXD,FILM:1K OHM,1%,0.125W	19701	5043ED1K00F
R1877	315-0220-00	B080000		RES.,FXD,CMPSN:22 OHM,5%,0.25W	57668	NTR25J-E 22E
R1877	----- -----			(1480C ONLY)		
R1877	315-0220-00	B090000		RES.,FXD,CMPSN:22 OHM,5%,0.25W	57668	NTR25J-E 22E
R1877	----- -----			(1480R ONLY)		
R1881	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	57668	NTR25J-E 100E
R1885	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	57668	NTR25J-E100K
R1887	315-0823-00			RES.,FXD,CMPSN:82K OHM,5%,0.25W	57668	NTR25J-E82K
R1889	321-0286-00			RES.,FXD,FILM:9.31K OHM,1%,0.125W	91637	MFF1816G93100F
R1891	315-0302-00			RES.,FXD,CMPSN:3K OHM,5%,0.25W	57668	NTR25J-E03K0
R1893	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	57668	NTR25J-E47K0
R1894	315-0133-00			RES.,FXD,CMPSN:13K OHM,5%,0.25W	57668	NTR25J-E 13K
R1895	315-0683-00			RES.,FXD,CMPSN:68K OHM,5%,0.25W	57668	NTR25J-E68K0
R1896	315-0333-00			RES.,FXD,CMPSN:33K OHM,5%,0.25W	57668	NTR25J-E33K0
R1897	315-0201-00			RES.,FXD,CMPSN:200 OHM,5%,0.25W	57668	NTR25J-E200E
R1899	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	57668	NTR25J-E470E
R1913	321-0236-03			RES.,FXD,FILM:2.8K OHM,0.25%,0.125W	91637	MFF1816D28000C
R1914	321-0073-00			RES.,FXD,FILM:56.2 OHM,1%,0.125W	91637	CMF55116G56R20F
R1915	321-0199-03			RES.,FXD,FILM:1.15K OHM,0.25%,0.125W	91637	MFF1816D11500C
R1921	321-0292-03			RES.,FXD,FILM:10.7K OHM,0.25%,0.125W	91637	MFF1816D10701C
R1945	321-0254-00			RES.,FXD,FILM:4.32K OHM,1%,0.125W	91637	MFF1816G43200F
R1953	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	57668	NTR25J-E 100E
R1955	321-0254-00			RES.,FXD,FILM:4.32K OHM,1%,0.125W	91637	MFF1816G43200F
R1975	321-0271-00			RES.,FXD,FILM:6.49K OHM,1%,0.125W	91637	MFF1816G64900F
R1977	321-0254-00			RES.,FXD,FILM:4.32K OHM,1%,0.125W	91637	MFF1816G43200F
R1991	321-0218-00			RES.,FXD,FILM:1.82K OHM,1%,0.125W	91637	MFF1816G18200F
R1992	315-0333-00			RES.,FXD,CMPSN:33K OHM,5%,0.25W	57668	NTR25J-E33K0
R2239	325-0104-00			RES.,FXD,FILM:9M OHM,1%,0.25W	03888	A3AT66
R2239	----- -----			(OPTION 01 ONLY)		
R2245	321-0486-00			RES.,FXD,FILM:1.13M OHM,1%,0.125W	91637	HMF188G11303F
R2245	----- -----			(OPTION 01 ONLY)		

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R2247	315-0474-00			RES.,FXD,CMPSN:470K OHM,5%,0.25W	57668	NTR25J-E470K
R2247	----- -----			(OPTION 01 ONLY)		
R2255	315-0682-00			RES.,FXD,CMPSN:6.8K OHM,5%,0.25W	57668	NTR25J-E06K8
R2255	----- -----			(OPTION 01 ONLY)		
R2256	315-0390-00	B060000	B093336	RES.,FXD,CMPSN:39 OHM,5%,0.25W	57668	NTR25J-E39E0
R2256	----- -----			(OPTION 01 ONLY)		
R2256	321-0010-00	B093337		RES.,FXD,FILM:12.4 OHM,1%,0.125W	91637	MFF1816G12R40F
R2256	----- -----			(OPTION 01 ONLY)		
R2261	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	57668	NTR25J-E 100E
R2261	----- -----			(OPTION 01 ONLY)		
R2264	315-0362-00			RES.,FXD,CMPSN:3.6K OHM,5%,0.25W	57668	NTR25J-E 3K6
R2264	----- -----			(OPTION 01 ONLY)		
R2266	321-0203-00			RES.,FXD,FILM:1.27K OHM,1%,0.125W	91637	CMF55116G12700F
R2266	----- -----			(OPTION 01 ONLY)		
R2271	315-0154-00			RES.,FXD,CMPSN:150K OHM,5%,0.25W	57668	NTR25J-E150K
R2271	----- -----			(OPTION 01 ONLY)		
R2272	315-0361-00			RES.,FXD,CMPSN:360 OHM,5%,0.25W	57668	NTR25J-E 360E
R2272	----- -----			(OPTION 01 ONLY)		
R2273	315-0332-00			RES.,FXD,CMPSN:3.3K OHM,5%,0.25W	57668	NTR25J-E03K3
R2273	----- -----			(OPTION 01 ONLY)		
R2275	311-1225-00			RES.,VAR,NONWIR:1K OHM,20%,0.50W	32997	3386F-T04-102
R2275	----- -----			(OPTION 01 ONLY)		
R2276	321-0255-00			RES.,FXD,FILM:4.42K OHM,1%,0.125W	91637	MFF1816G44200F
R2276	----- -----			(OPTION 01 ONLY)		
R2278	321-0285-00			RES.,FXD,FILM:9.09K OHM,1%,0.125W	91637	MFF1816G90900F
R2278	----- -----			(OPTION 01 ONLY)		
R2279	321-0193-00			RES.,FXD,FILM:1K OHM,1%,0.125W	19701	5043ED1K00F
R2279	----- -----			(OPTION 01 ONLY)		
R3010	321-0330-00			RES.,FXD,FILM:26.7K OHM,1%,0.125W	91637	MFF1816G26701F
R3011	321-0232-00			RES.,FXD,FILM:2.55K OHM,1%,0.125W	24546	CT552551F
R3015	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816G10001F
R3020	321-0316-00			RES.,FXD,FILM:19.1K OHM,1%,0.125W	91637	MFF1816G19101F
R3021	321-0315-00			RES.,FXD,FILM:18.7K OHM,1%,0.125W	91637	CMF55-116G18701F
R3030	321-0239-00			RES.,FXD,FILM:3.01K OHM,1%,0.125W	24546	CT55 3011 F
R3031	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	57668	NTR25JE01K0
R3032	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	57668	NTR25JE01K0
R3033	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	57668	NTR25J-E04K7
R3040	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	57668	NTR25J-E100K
R3050	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	57668	NTR255-E 1M
R3051	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	57668	NTR25J-E04K7
R3052	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	57668	NTR25J-E100K
R3053	315-0152-00			RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	57668	NTR25J-E01K5
R3060	321-0332-00			RES.,FXD,FILM:28K OHM,1%,0.125W	91637	MFF1816G28001F
R3061	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	57668	NTR25JE01K0
R3062	315-0512-00			RES.,FXD,CMPSN:5.1K OHM,5%,0.25W	57668	NTR25J-E05K1
R3080	321-0356-00			RES.,FXD,FILM:49.9K OHM,1%,0.125W	91637	MFF1816G49901F
R3081	315-0221-00			RES.,FXD,CMPSN:220 OHM,5%,0.25W	57668	NTR25J-E220E
R3082	315-0221-00			RES.,FXD,CMPSN:220 OHM,5%,0.25W	57668	NTR25J-E220E
R3090	315-0181-00			RES.,FXD,CMPSN:180 OHM,5%,0.25W	57668	NTR25J-E180E
R3091	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	57668	NTR25J-E 15K
R3092	315-0220-00			RES.,FXD,CMPSN:22 OHM,5%,0.25W	57668	NTR25J-E 22E
R3110	315-0513-00			RES.,FXD,CMPSN:51K OHM,5%,0.25W	57668	NTR25J-E51K0
R3111	315-0513-00			RES.,FXD,CMPSN:51K OHM,5%,0.25W	57668	NTR25J-E51K0
R3112	315-0162-00			RES.,FXD,CMPSN:1.6K OHM,5%,0.25W	57668	NTR25J-E 1K6

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R3113	315-0753-00			RES.,FXD,CMPSN:75K OHM,5%,0.25W	57668	NTR25J-E75K0
R3114	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	57668	NTR25J-E100K
R3120	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	57668	NTR25J-E 100E
R3130	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	57668	NTR25J-E 100E
R3131	315-0393-00			RES.,FXD,CMPSN:39K OHM,5%,0.25W	57668	NTR25J-E39K0
R3132	316-0336-00			RES.,FXD,CMPSN:33M OHM,10%,0.25W	01121	CB3361
R3133	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	57668	NTR25J-E 100E
R3134	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	57668	NTR25JE01K0
R3135	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	57668	NTR25JE01K0
R3136	315-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.25W	57668	NTR25J-E02K0
R3140	321-0327-00			RES.,FXD,FILM:24.9K OHM,1%,0.125W	91637	MFF1816G24901F
R3141	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	57668	NTR25J-E10K0
R3142	315-0272-00			RES.,FXD,CMPSN:2.7K OHM,5%,0.25W	57668	NTR25J-E02K7
R3150	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	57668	NTR25J-E470E
R3151	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816G10001F
R3160	321-0332-00			RES.,FXD,FILM:28K OHM,1%,0.125W	91637	MFF1816G28001F
R3161	321-0222-00			RES.,FXD,FILM:2K OHM,1%,0.125W	91637	MFF1816G20000F
R3172	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	57668	NTR25JE01K0
R3173	315-0183-00			RES.,FXD,CMPSN:18K OHM,5%,0.25W	57668	NTR25J-E 18K
R3174	315-0621-00			RES.,FXD,CMPSN:620 OHM,5%,0.25W	57668	NTR25J-E620E
R3175	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	57668	NTR25J-E10K0
R3181	315-0433-00			RES.,FXD,CMPSN:43K OHM,5%,0.25W	57668	NTR25J-E043K
R3182	315-0754-00			RES.,FXD,CMPSN:750K OHM,5%,0.25W	57668	NTR25J-E 750K
R3183	315-0914-00			RES.,FXD,CMPSN:910K OHM,5%,0.25W	57668	NTR25J-E 910K
R3184	321-0357-00			RES.,FXD,FILM:51.1K OHM,1%,0.125W	91637	MFF1816G51101F
R3190	315-0273-00			RES.,FXD,CMPSN:27K OHM,5%,0.25W	57668	NTR25J-E27K0
R3191	315-0751-00			RES.,FXD,CMPSN:750 OHM,5%,0.25W	57668	NTR25J-E750E
R3192	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	57668	NTR25J-E04K7
R3194	315-0270-00	B060000	B062277	RES.,FXD,CMPSN:27 OHM,5%,0.25W	57668	NTR25J-E 27E
R3194	----- -----			(1480C ONLY)		
R3194	315-0470-00	B062278		RES.,FXD,CMPSN:47 OHM,5%,0.25W	57668	NTR25J-E47E0
R3194	----- -----			(1480C ONLY)		
R3194	315-0270-00	B060000	B066245	RES.,FXD,CMPSN:27 OHM,5%,0.25W	57668	NTR25J-E 27E
R3194	----- -----			(1480R ONLY)		
R3194	315-0470-00	B066246		RES.,FXD,CMPSN:47 OHM,5%,0.25W	57668	NTR25J-E47E0
R3194	----- -----			(1480R ONLY)		
R3200	315-0562-00			RES.,FXD,CMPSN:5.6K OHM,5%,0.25W	57668	NTR25J-E05K6
R3210	321-0254-00			RES.,FXD,FILM:4.32K OHM,1%,0.125W	91637	MFF1816G43200F
R3211	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	57668	NTR25J-E100K
R3212	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	57668	NTR25J-E10K0
R3213	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816G10001F
R3220	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	57668	NTR25J-E100K
R3221	321-0385-00			RES.,FXD,FILM:100K OHM,1%,0.125W	91637	MFF1816G10002F
R3222	321-0385-00			RES.,FXD,FILM:100K OHM,1%,0.125W	91637	MFF1816G10002F
R3223	321-0302-00			RES.,FXD,FILM:13.7K OHM,1%,0.125W	91637	MFF1816G13701F
R3224	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	57668	NTR25J-E 10E0
R3225	321-0254-00			RES.,FXD,FILM:4.32K OHM,1%,0.125W	91637	MFF1816G43200F
R3230	321-0331-00			RES.,FXD,FILM:27.4K OHM,1%,0.125W	91637	MFF1816G27401F
R3231	321-0247-00			RES.,FXD,FILM:3.65K OHM,1%,0.125W	91637	CMF55116G36500F
R3232	321-0267-00			RES.,FXD,FILM:5.9K OHM,1%,0.125W	91637	MFF1816G59000F
R3233	321-0261-00			RES.,FXD,FILM:5.11K OHM,1%,0.125W	91637	MFF1816G51100F
R3240	321-0273-00			RES.,FXD,FILM:6.81K OHM,1%,0.125W	91637	MFF1816G68100F
R3241	321-0261-00			RES.,FXD,FILM:5.11K OHM,1%,0.125W	91637	MFF1816G51100F
R3252	315-0303-00			RES.,FXD,CMPSN:30K OHM,5%,0.25W	57668	NTR25J-E 30K

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R3253	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	57668	NTR25J-E100K
R3254	315-0163-00			RES.,FXD,CMPSN:16K OHM,5%,0.25W	57668	NTR25J-E16K0
R3255	315-0623-00			RES.,FXD,CMPSN:62K OHM,5%,0.25W	57668	NTR25J-E 62K
R3256	315-0754-00			RES.,FXD,CMPSN:750K OHM,5%,0.25W	57668	NTR25J-E 750K
R3261	315-0204-00			RES.,FXD,CMPSN:200K OHM,5%,0.25W	57668	NTR25J-E 200K
R3262	311-1230-00			RES.,VAR,NONWIR:20K OHM,20%,0.50W	32997	3386F-T04-203
R3265	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	57668	NTR25JE01K0
R3267	315-0512-00			RES.,FXD,CMPSN:5.1K OHM,5%,0.25W	57668	NTR25J-E05K1
R3269	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	57668	NTR25J-E10K0
R3270	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	57668	NTR25J-E47K0
R3271	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	57668	NTR25J-E10K0
R3273	315-0624-00			RES.,FXD,CMPSN:620K OHM,5%,0.25W	57668	NTR25J-E 620K
R3274	315-0512-00			RES.,FXD,CMPSN:5.1K OHM,5%,0.25W	57668	NTR25J-E05K1
R3275	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	57668	NTR25J-E10K0
R3277	315-0302-00			RES.,FXD,CMPSN:3K OHM,5%,0.25W	57668	NTR25J-E03K0
R3279	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	57668	NTR25JE01K0
R3281	315-0822-00			RES.,FXD,CMPSN:8.2K OHM,5%,0.25W	57668	NTR25J-E 8K2
R3282	316-0126-00			RES.,FXD,CMPSN:12M OHM,10%,0.25W	01121	CB1261
R3290	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	57668	NTR25J-E04K7
R3310	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	57668	NTR25JE01K0
R3320	315-0562-00			RES.,FXD,CMPSN:5.6K OHM,5%,0.25W	57668	NTR25J-E05K6
R3321	315-0562-00			RES.,FXD,CMPSN:5.6K OHM,5%,0.25W	57668	NTR25J-E05K6
R3330	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	57668	NTR25JE01K0
R3340	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	57668	NTR25J-E47E0
R3341	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	57668	NTR25J-E 15K
R3343	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	57668	NTR25J-E04K7
R3344	315-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.25W	57668	NTR25J-E02K0
R3346	315-0133-00			RES.,FXD,CMPSN:13K OHM,5%,0.25W	57668	NTR25J-E 13K
R3350	315-0392-00			RES.,FXD,CMPSN:3.9K OHM,5%,0.25W	57668	NTR25J-E03K9
R3351	315-0562-00			RES.,FXD,CMPSN:5.6K OHM,5%,0.25W	57668	NTR25J-E05K6
R3354	315-0152-00			RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	57668	NTR25J-E01K5
R3355	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	57668	NTR25J-E 15K
R3361	315-0122-00			RES.,FXD,CMPSN:1.2K OHM,5%,0.25W	57668	NTR25J-E01K2
R3373	315-0823-00			RES.,FXD,CMPSN:82K OHM,5%,0.25W	57668	NTR25J-E82K
R3374	321-0373-00			RES.,FXD,FILM:75K OHM, 1%,0.125W	91637	MFF1816G75001F
R3380	321-0415-00			RES.,FXD,FILM:205K OHM,1%,0.125W	91637	MFF1816G20502F
R3381	321-0452-00			RES.,FXD,FILM:499K OHM,1%,0.125W	91637	CMF55116G49902F
R3382	321-0510-00			RES.,FXD,FILM:2M OHM,1%,0.125W	91637	HFF188G20003F
R3390	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	57668	NTR25J-E04K7
R3391	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	57668	NTR25J-E10K0
R3392	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	57668	NTR25J-E10K0
R3393	315-0821-00			RES.,FXD,CMPSN:820 OHM,5%,0.25W	57668	NTR25J-E 820E
R3400	315-0562-00			RES.,FXD,CMPSN:5.6K OHM,5%,0.25W	57668	NTR25J-E05K6
R3401	315-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.25W	57668	NTR25J-E02K0
R3402	315-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.25W	57668	NTR25J-E02K0
R3410	315-0220-00			RES.,FXD,CMPSN:22 OHM,5%,0.25W	57668	NTR25J-E 22E
R3411	321-0306-00			RES.,FXD,FILM:15K OHM,1%,0.125W	91637	MFF1816G15001F
R3420	315-0220-00			RES.,FXD,CMPSN:22 OHM,5%,0.25W	57668	NTR25J-E 22E
R3421	315-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.25W	57668	NTR25J-E02K0
R3422	315-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.25W	57668	NTR25J-E02K0
R3430	321-0306-00			RES.,FXD,FILM:15K OHM,1%,0.125W	91637	MFF1816G15001F
R3431	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	57668	NTR25J-E04K7
R3440	315-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.25W	57668	NTR25J-E02K0
R3441	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	57668	NTR25J-E 100E

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R3442	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	57668	NTR25J-E47E0
R3450	315-0512-00			RES.,FXD,CMPSN:5.1K OHM,5%,0.25W	57668	NTR25J-E05K1
R3451	315-0152-00			RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	57668	NTR25J-E01K5
R3460	315-0154-00			RES.,FXD,CMPSN:150K OHM,5%,0.25W	57668	NTR25J-E150K
R3470	315-0752-00			RES.,FXD,CMPSN:7.5K OHM,5%,0.25W	57668	NTR25J-E07K5
R3471	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	57668	NTR25J-E 100E
R3480	315-0475-00			RES.,FXD,CMPSN:4.7M OHM,5%,0.25W	01121	CB4755
R3481	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	57668	NTR25J-E 100E
R3482	315-0106-00			RES.,FXD,CMPSN:10M OHM,5%,0.25W	01121	CB1065
R3490	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	57668	NTR25J-E10K0
R4000	321-0305-00			RES.,FXD,FILM:14.7K OHM,1%,0.125W	91637	MFF1816G14701F
R4001	321-0151-00			RES.,FXD,FILM:365 OHM,1%,0.125W	91637	CMF55116G365R0F
R4011	315-0181-00	B060000	B073580	RES.,FXD,CMPSN:180 OHM,5%,0.25W	57668	NTR25J-E180E
R4011	----- -----			(1480C ONLY)		
R4011	315-0111-00	B073581		RES.,FXD,CMPSN:110 OHM,5%,0.25W	57668	NTR25J-E110E
R4011	----- -----			(1480C ONLY)		
R4011	315-0181-00	B060000	B081486	RES.,FXD,CMPSN:180 OHM,5%,0.25W	57668	NTR25J-E180E
R4011	----- -----			(1480R ONLY)		
R4011	315-0111-00	B081487		RES.,FXD,CMPSN:110 OHM,5%,0.25W	57668	NTR25J-E110E
R4011	----- -----			(1480R ONLY)		
R4011	315-0181-00	B060000	B073579	RES.,FXD,CMPSN:180 OHM,5%,0.25W	57668	NTR25J-E180E
R4011	----- -----			(1481C ONLY)		
R4011	315-0111-00	B073580		RES.,FXD,CMPSN:110 OHM,5%,0.25W	57668	NTR25J-E110E
R4011	----- -----			(1481C ONLY)		
R4011	315-0181-00	B060000	B081484	RES.,FXD,CMPSN:180 OHM,5%,0.25W	57668	NTR25J-E180E
R4011	----- -----			(1481R ONLY)		
R4011	315-0111-00	B081485		RES.,FXD,CMPSN:110 OHM,5%,0.25W	57668	NTR25J-E110E
R4011	----- -----			(1481R ONLY)		
R4011	315-0181-00	B060000	B073439	RES.,FXD,CMPSN:180 OHM,5%,0.25W	57668	NTR25J-E180E
R4011	----- -----			(1482C ONLY)		
R4011	315-0111-00	B073440		RES.,FXD,CMPSN:110 OHM,5%,0.25W	57668	NTR25J-E110E
R4011	----- -----			(1482C ONLY)		
R4011	315-0181-00	B060000	B081430	RES.,FXD,CMPSN:180 OHM,5%,0.25W	57668	NTR25J-E180E
R4011	----- -----			(1482R ONLY)		
R4011	315-0111-00	B081431		RES.,FXD,CMPSN:110 OHM,5%,0.25W	57668	NTR25J-E110E
R4011	----- -----			(1482R ONLY)		
R4011	315-0181-00	B060000	B073551	RES.,FXD,CMPSN:180 OHM,5%,0.25W	57668	NTR25J-E180E
R4011	----- -----			(1485C ONLY)		
R4011	315-0111-00	B073552		RES.,FXD,CMPSN:110 OHM,5%,0.25W	57668	NTR25J-E110E
R4011	----- -----			(1485C ONLY)		
R4011	315-0181-00	B060000	B081492	RES.,FXD,CMPSN:180 OHM,5%,0.25W	57668	NTR25J-E180E
R4011	----- -----			(1485R ONLY)		
R4011	315-0111-00	B081493		RES.,FXD,CMPSN:110 OHM,5%,0.25W	57668	NTR25J-E110E
R4011	----- -----			(1485R ONLY)		
R4012	321-0245-00			RES.,FXD,FILM:3.48K OHM,1%,0.125W	91637	MFF1816G34800F
R4013	321-0312-00	B060000	B073580	RES.,FXD,FILM:17.4K OHM,1%,0.125W	91637	MFF1816G17401F
R4013	----- -----			(1480C ONLY)		
R4013	321-0245-00	B073581		RES.,FXD,FILM:3.48K OHM,1%,0.125W	91637	MFF1816G34800F
R4013	----- -----			(1480C ONLY)		
R4013	321-0312-00	B060000	B081486	RES.,FXD,FILM:17.4K OHM,1%,0.125W	91637	MFF1816G17401F
R4013	----- -----			(1480R ONLY)		
R4013	321-0245-00	B081487		RES.,FXD,FILM:3.48K OHM,1%,0.125W	91637	MFF1816G34800F
R4013	----- -----			(1480R ONLY)		

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R4013	321-0312-00	B060000	B073579	RES.,FXD,FILM:17.4K OHM,1%,0.125W	91637	MFF1816G17401F
R4013	----- -----			(1481C ONLY)		
R4013	321-0245-00	B073580		RES.,FXD,FILM:3.48K OHM,1%,0.125W	91637	MFF1816G34800F
R4013	----- -----			(1481C ONLY)		
R4013	321-0312-00	B060000	B081484	RES.,FXD,FILM:17.4K OHM,1%,0.125W	91637	MFF1816G17401F
R4013	----- -----			(1481R ONLY)		
R4013	321-0245-00	B081485		RES.,FXD,FILM:3.48K OHM,1%,0.125W	91637	MFF1816G34800F
R4013	----- -----			(1481R ONLY)		
R4013	321-0312-00	B060000	B073439	RES.,FXD,FILM:17.4K OHM,1%,0.125W	91637	MFF1816G17401F
R4013	----- -----			(1482C ONLY)		
R4013	321-0245-00	B073440		RES.,FXD,FILM:3.48K OHM,1%,0.125W	91637	MFF1816G34800F
R4013	----- -----			(1482C ONLY)		
R4013	321-0312-00	B060000	B081430	RES.,FXD,FILM:17.4K OHM,1%,0.125W	91637	MFF1816G17401F
R4013	----- -----			(1482R ONLY)		
R4013	321-0245-00	B081431		RES.,FXD,FILM:3.48K OHM,1%,0.125W	91637	MFF1816G34800F
R4013	----- -----			(1482R ONLY)		
R4013	321-0312-00	B060000	B073551	RES.,FXD,FILM:17.4K OHM,1%,0.125W	91637	MFF1816G17401F
R4013	----- -----			(1485C ONLY)		
R4013	321-0245-00	B073552		RES.,FXD,FILM:3.48K OHM,1%,0.125W	91637	MFF1816G34800F
R4013	----- -----			(1485C ONLY)		
R4013	321-0312-00	B060000	B081492	RES.,FXD,FILM:17.4K OHM,1%,0.125W	91637	MFF1816G17401F
R4013	----- -----			(1485R ONLY)		
R4013	321-0245-00	B081493		RES.,FXD,FILM:3.48K OHM,1%,0.125W	91637	MFF1816G34800F
R4013	----- -----			(1485R ONLY)		
R4020	321-0391-00	B060000	B073580	RES.,FXD,FILM:115K OHM,1%,0.125K	91637	MFF1816G11502F
R4020	----- -----			(1480C ONLY)		
R4020	321-0277-00	B073581		RES.,FXD,FILM:7.5K OHM,1%,0.125W	91637	MFF1816G75000F
R4020	----- -----			(1480C ONLY)		
R4020	321-0391-00	B060000	B081486	RES.,FXD,FILM:115K OHM,1%,0.125K	91637	MFF1816G11502F
R4020	----- -----			(1480R ONLY)		
R4020	321-0277-00	B081487		RES.,FXD,FILM:7.5K OHM,1%,0.125W	91637	MFF1816G75000F
R4020	----- -----			(1480R ONLY)		
R4020	321-0391-00	B060000	B073579	RES.,FXD,FILM:115K OHM,1%,0.125K	91637	MFF1816G11502F
R4020	----- -----			(1481C ONLY)		
R4020	321-0277-00	B073580		RES.,FXD,FILM:7.5K OHM,1%,0.125W	91637	MFF1816G75000F
R4020	----- -----			(1481C ONLY)		
R4020	321-0391-00	B060000	B081484	RES.,FXD,FILM:115K OHM,1%,0.125K	91637	MFF1816G11502F
R4020	----- -----			(1481R ONLY)		
R4020	321-0277-00	B081485		RES.,FXD,FILM:7.5K OHM,1%,0.125W	91637	MFF1816G75000F
R4020	----- -----			(1481R ONLY)		
R4020	321-0391-00	B060000	B073439	RES.,FXD,FILM:115K OHM,1%,0.125K	91637	MFF1816G11502F
R4020	----- -----			(1482C ONLY)		
R4020	321-0277-00	B073440		RES.,FXD,FILM:7.5K OHM,1%,0.125W	91637	MFF1816G75000F
R4020	----- -----			(1482C ONLY)		
R4020	321-0391-00	B060000	B081430	RES.,FXD,FILM:115K OHM,1%,0.125K	91637	MFF1816G11502F
R4020	----- -----			(1482R ONLY)		
R4020	321-0277-00	B081431		RES.,FXD,FILM:7.5K OHM,1%,0.125W	91637	MFF1816G75000F
R4020	----- -----			(1482R ONLY)		
R4020	321-0391-00	B060000	B073551	RES.,FXD,FILM:115K OHM,1%,0.125K	91637	MFF1816G11502F
R4020	----- -----			(1485C ONLY)		
R4020	321-0277-00	B073552		RES.,FXD,FILM:7.5K OHM,1%,0.125W	91637	MFF1816G75000F
R4020	----- -----			(1485C ONLY)		

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R4020	321-0391-00	B060000	B081492	RES.,FXD,FILM:115K OHM,1%,0.125K	91637	MFF1816G11502F
R4020	----- -----			(1485R ONLY)		
R4020	321-0277-00	B081493		RES.,FXD,FILM:7.5K OHM,1%,0.125W	91637	MFF1816G75000F
R4020	----- -----			(1485R ONLY)		
R4022	321-0287-00			RES.,FXD,FILM:9.53K OHM,1%,0.125W	91637	MFF1816G95300F
R4022	----- -----			(1480C,1481C,1482C,1485C ONLY)		
R4022	321-0632-00			RES.,FXD,FILM:9.41K OHM,0.5%,0.125W	91637	MFF1816D94100C
R4022	----- -----			(1480C,1481C,1482C,1485C ONLY)		
R4022	321-0287-00			RES.,FXD,FILM:9.53K OHM,1%,0.125W	91637	MFF1816G95300F
R4022	----- -----			(1480R,1481R,1482R,1485R ONLY)		
R4022	321-0632-00			RES.,FXD,FILM:9.41K OHM,0.5%,0.125W	91637	MFF1816D94100C
R4022	----- -----			(1480R,1481R,1482R,1485R ONLY)		
R4025	321-0306-00			RES.,FXD,FILM:15K OHM,1%,0.125W	91637	MFF1816G15001F
R4032	321-0277-00			RES.,FXD,FILM:7.5K OHM,1%,0.125W	91637	MFF1816G75000F
R4040	311-1254-00			RES.,VAR,NONWIR:1M OHM,20%,0.50W	73138	72-18-0
R4052	315-0754-00			RES.,FXD,CMPSN:750K OHM,5%,0.25W	57668	NTR25J-E 750K
R4060	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	57668	NTR255-E 1M
R4070	321-0481-00			RES.,FXD,FILM:1M OHM,1%,0.125W	91637	CMF55116G10003F
R4100	321-0286-00			RES.,FXD,FILM:9.31K OHM,1%,0.125W	91637	MFF1816G93100F
R4120	321-0322-00	B060000	B073580	RES.,FXD,FILM:22.1K OHM,1%,0.125W	91637	MFF1816G22101F
R4120	----- -----			(1480C ONLY)		
R4120	321-0255-00	B073581		RES.,FXD,FILM:4.42K OHM,1%,0.125W	91637	MFF1816G44200F
R4120	----- -----			(1480C ONLY)		
R4120	321-0322-00	B060000	B081486	RES.,FXD,FILM:22.1K OHM,1%,0.125W	91637	MFF1816G22101F
R4120	----- -----			(1480R ONLY)		
R4120	321-0255-00	B081487		RES.,FXD,FILM:4.42K OHM,1%,0.125W	91637	MFF1816G44200F
R4120	----- -----			(1480R ONLY)		
R4120	321-0322-00	B060000	B073597	RES.,FXD,FILM:22.1K OHM,1%,0.125W	91637	MFF1816G22101F
R4120	----- -----			(1481C ONLY)		
R4120	321-0255-00	B073580		RES.,FXD,FILM:4.42K OHM,1%,0.125W	91637	MFF1816G44200F
R4120	----- -----			(1481C ONLY)		
R4120	321-0322-00	B060000	B081484	RES.,FXD,FILM:22.1K OHM,1%,0.125W	91637	MFF1816G22101F
R4120	----- -----			(1481R ONLY)		
R4120	321-0255-00	B081485		RES.,FXD,FILM:4.42K OHM,1%,0.125W	91637	MFF1816G44200F
R4120	----- -----			(1481R ONLY)		
R4120	321-0322-00	B060000	B073439	RES.,FXD,FILM:22.1K OHM,1%,0.125W	91637	MFF1816G22101F
R4120	----- -----			(1482C ONLY)		
R4120	321-0255-00	B073440		RES.,FXD,FILM:4.42K OHM,1%,0.125W	91637	MFF1816G44200F
R4120	----- -----			(1482C ONLY)		
R4120	321-0322-00	B060000	B081430	RES.,FXD,FILM:22.1K OHM,1%,0.125W	91637	MFF1816G22101F
R4120	----- -----			(1482R ONLY)		
R4120	321-0255-00	B081431		RES.,FXD,FILM:4.42K OHM,1%,0.125W	91637	MFF1816G44200F
R4120	----- -----			(1482R ONLY)		
R4120	321-0322-00	B060000	B073551	RES.,FXD,FILM:22.1K OHM,1%,0.125W	91637	MFF1816G22101F
R4120	----- -----			(1485C ONLY)		
R4120	321-0255-00	B073552		RES.,FXD,FILM:4.42K OHM,1%,0.125W	91637	MFF1816G44200F
R4120	----- -----			(1485C ONLY)		
R4120	321-0322-00	B060000	B081492	RES.,FXD,FILM:22.1K OHM,1%,0.125W	91637	MFF1816G22101F
R4120	----- -----			(1485R ONLY)		
R4120	321-0255-00	B081493		RES.,FXD,FILM:4.42K OHM,1%,0.125W	91637	MFF1816G44200F
R4120	----- -----			(1485R ONLY)		
R4122	315-0824-00			RES.,FXD,CMPSN:820K OHM,5%,0.25W	57668	NTR25J-E 820K

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R4123	321-0272-00	B060000	B073731	RES.,FXD,FILM:6.65K OHM,1%,0.125W	91637	MFF1816G66500F
R4123	----- -----			(1480C ONLY)		
R4123	321-1271-00	B073732		RES.,FXD,FILM:6.57K OHM,1%,0.125W	19701	5043ED6K270F
R4123	----- -----			(1480C ONLY)		
R4123	321-0272-00	B060000	B082413	RES.,FXD,FILM:6.65K OHM,1%,0.125W	91637	MFF1816G66500F
R4123	----- -----			(1480R ONLY)		
R4123	321-1271-00	B082414		RES.,FXD,FILM:6.65K OHM,1%,0.125W	91637	MFF1816G66500F
R4123	----- -----			(1480R ONLY)		
R4124	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	57668	NTR25J-E04K7
R4125	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	57668	NTR25J-E04K7
R4131	321-0271-00			RES.,FXD,FILM:6.49K OHM,1%,0.125W	91637	MFF1816G64900F
R4132	315-0683-00			RES.,FXD,CMPSN:68K OHM,5%,0.25W	57668	NTR25J-E68K0
R4133	321-0271-00			RES.,FXD,FILM:6.49K OHM,1%,0.125W	91637	MFF1816G64900F
R4134	321-0323-00			RES.,FXD,FILM:22.6K OHM,1%,0.125W	91637	MFF1816G22601F
R4140	321-0331-00			RES.,FXD,FILM:27.4K OHM,1%,0.125W	91637	MFF1816G27401F
R4146	321-0603-07			RES.,FXD,FILM:15K OHM,0.1%,0.125W	91637	MFF1816C15001B
R4148	321-0271-00			RES.,FXD,FILM:6.49K OHM,1%,0.125W	91637	MFF1816G64900F
R4151	321-0272-00	B060000	B073731	RES.,FXD,FILM:6.65K OHM,1%,0.125W	91637	MFF1816G66500F
R4151	----- -----			(1480C ONLY)		
R4151	321-1271-00	B073732		RES.,FXD,FILM:6.57K OHM,1%,0.125W	19701	5043ED6K270F
R4151	----- -----			(1480C ONLY)		
R4151	321-0272-00	B060000	B082413	RES.,FXD,FILM:6.65K OHM,1%,0.125W	91637	MFF1816G66500F
R4151	----- -----			(1480R ONLY)		
R4151	321-1271-00	B082414		RES.,FXD,FILM:6.65K OHM,1%,0.125W	91637	MFF1816G66500F
R4151	----- -----			(1480R ONLY)		
R4153	321-0277-03			RES.,FXD,FILM:7.5K OHM,0.25%,0.125W	24546	NC55C7501C
R4160	315-0154-00			RES.,FXD,CMPSN:150K OHM,5%,0.25W	57668	NTR25J-E150K
R4161	315-0152-00			RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	57668	NTR25J-E01K5
R4170	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	57668	NTR25J-E47K0
R4171	321-0337-00			RES.,FXD,FILM:31.6K OHM,1%,0.125W	91637	MFF1816G31601F
R4172	321-0295-00			RES.,FXD,FILM:11.5K OHM,1%,0.125W	91637	MFF1816G11501F
R4173	321-0241-00			RES.,FXD,FILM:3.16K OHM,1%,0.125W	91637	MFF1816G31600F
R4190	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	57668	NTR25J-E10K0
R4191	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	57668	NTR25J-E10K0
R4200	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	57668	NTR25J-E47K0
R4201	321-0242-00			RES.,FXD,FILM:3.24K OHM,1%,0.125W	24546	CT55 3241 F
R4210	321-0306-00			RES.,FXD,FILM:15K OHM,1%,0.125W	91637	MFF1816G15001F
R4211	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	57668	NTR25J-E100K
R4212	315-0753-00			RES.,FXD,CMPSN:75K OHM,5%,0.25W	57668	NTR25J-E75K0
R4220	315-0183-00			RES.,FXD,CMPSN:18K OHM,5%,0.25W	57668	NTR25J-E 18K
R4221	321-0288-00			RES.,FXD,FILM:9.76K OHM,1%,0.125W	91637	MFF1816G97600F
R4222	321-0307-00			RES.,FXD,FILM:15.4K OHM,1%,0.125W	91637	MFF1816G15401F
R4223	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816G10001F
R4224	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	57668	NTR25J-E10K0
R4231	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	57668	NTR25J-E 100E
R4232	315-0242-00			RES.,FXD,CMPSN:2.4K OHM,5%,0.25W	57668	NTR25J-E02K4
R4233	315-0162-00			RES.,FXD,CMPSN:1.6K OHM,5%,0.25W	57668	NTR25J-E 1K6
R4234	311-1263-00			RES.,VAR,NONWIR:1K OHM,10%,0.50W	32997	3329P-L58-102
R4240	311-1265-00			RES.,VAR,NONWIR:2K OHM,10%,0.50W	32997	3329P-L58-202
R4241	321-0271-00			RES.,FXD,FILM:6.49K OHM,1%,0.125W	91637	MFF1816G64900F
R4242	321-0331-00			RES.,FXD,FILM:27.4K OHM,1%,0.125W	91637	MFF1816G27401F
R4250	321-0323-00			RES.,FXD,FILM:22.6K OHM,1%,0.125W	91637	MFF1816G22601F
R4251	321-0277-00			RES.,FXD,FILM:7.5K OHM,1%,0.125W	91637	MFF1816G75000F
R4270	321-0279-00			RES.,FXD,FILM:7.87K OHM,1%,0.125W	91637	MFF1816G78700F

	Tektronix	Serial/Model No.			Mfr	
Ckt No.	Part No.	Eff	Dscont	Name & Description	Code	Mfr Part Number
R4300	315-0332-00			RES.,FXD,CMPSN:3.3K OHM,5%,0.25W	57668	NTR25J-E03K3
R4301	315-0332-00			RES.,FXD,CMPSN:3.3K OHM,5%,0.25W	57668	NTR25J-E03K3
R4302	315-0332-00			RES.,FXD,CMPSN:3.3K OHM,5%,0.25W	57668	NTR25J-E03K3
R4310	315-0332-00			RES.,FXD,CMPSN:3.3K OHM,5%,0.25W	57668	NTR25J-E03K3
R4311	315-0243-00			RES.,FXD,CMPSN:24K OHM,5%,0.25W	57668	NTR25J-E24K0
R4312	315-0243-00			RES.,FXD,CMPSN:24K OHM,5%,0.25W	57668	NTR25J-E24K0
R4313	315-0243-00			RES.,FXD,CMPSN:24K OHM,5%,0.25W	57668	NTR25J-E24K0
R4314	315-0243-00			RES.,FXD,CMPSN:24K OHM,5%,0.25W	57668	NTR25J-E24K0
R4320	321-0242-00			RES.,FXD,FILM:3.24K OHM,1%,0.125W	24546	CT55 3241 F
R4322	321-0220-00			RES.,FXD,FILM:1.91K OHM,1%,0.125W	91637	MFF1816G19100F
R4323	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	57668	NTR25J-E10K0
R4325	321-0261-00			RES.,FXD,FILM:5.11K OHM,1%,0.125W	91637	MFF1816G51100F
R4330	311-1265-00			RES.,VAR,NONWIR:2K OHM,10%,0.50W	32997	3329P-L58-202
R4331	315-0303-00			RES.,FXD,CMPSN:30K OHM,5%,0.25W	57668	NTR25J-E 30K
R4332	323-0295-00			RES.,FXD,FILM:11.5K OHM,1%,0.50W	75042	CECT0-1152F
R4333	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	57668	NTR25J-E04K7
R4340	315-0203-00			RES.,FXD,CMPSN:20K OHM,5%,0.25W	57668	NTR25J-E20K0
R4341	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	57668	NTR25J-E10K0
R4342	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	57668	NTR25J-E 10E0
R4350	321-0411-00			RES.,FXD,FILM:187K OHM,1%,0.125W	91637	MFF1816G18702F
R4351	321-0181-00			RES.,FXD,FILM:750 OHM,1%,0.125W	91637	CMF55116G750R0F
R4352	315-0682-00			RES.,FXD,CMPSN:6.8K OHM,5%,0.25W	57668	NTR25J-E06K8
R4370	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	57668	NTR25J-E10K0
R4371	315-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.25W	57668	NTR25J-E 22K
R4372	315-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.25W	57668	NTR25J-E 22K
R4381	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	57668	NTR25J-E10K0
R4382	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	57668	NTR25J-E10K0
R4383	315-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.25W	57668	NTR25J-E 22K
R4384	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	57668	NTR25J-E10K0
R4390	315-0183-00			RES.,FXD,CMPSN:18K OHM,5%,0.25W	57668	NTR25J-E 18K
R4400	315-0682-00			RES.,FXD,CMPSN:6.8K OHM,5%,0.25W	57668	NTR25J-E06K8
R4401	321-0261-00			RES.,FXD,FILM:5.11K OHM,1%,0.125W	91637	MFF1816G51100F
R4401	----- -----			(END USAGE 670-3488-24 1480C/R,1481C/R		
R4401	----- -----			,1482C/R,1485C/R ONLY)		
R4401	321-0271-00			RES.,FXD,FILM:6.49K OHM,1%,0.125W	91637	MFF1816G64900F
R4401	----- -----			(BEGIN USAGE 670-3488-30 1480C/R,1481C/R		
R4401	----- -----			,1482C/R,1485C ONLY)		
R4402	315-0682-00			RES.,FXD,CMPSN:6.8K OHM,5%,0.25W	57668	NTR25J-E06K8
R4410	315-0682-00			RES.,FXD,CMPSN:6.8K OHM,5%,0.25W	57668	NTR25J-E06K8
R4411	315-0682-00			RES.,FXD,CMPSN:6.8K OHM,5%,0.25W	57668	NTR25J-E06K8
R4412	321-0184-00			RES.,FXD,FILM:806 OHM,1%,0.125W	91637	CMF55116G806R0F
R4413	321-0266-00			RES.,FXD,FILM:5.76K OHM,1%,0.125W	91637	MFF1816G57600F
R4414	321-0266-00			RES.,FXD,FILM:5.76K OHM,1%,0.125W	91637	MFF1816G57600F
R4420	321-0202-00			RES.,FXD,FILM:1.24K OHM,1%,0.125W	91637	CMF55116G12400F
R4422	315-0822-00			RES.,FXD,CMPSN:8.2K OHM,5%,0.25W	57668	NTR25J-E 8K2
R4423	322-0324-00			RES.,FXD,FILM:23.2K OHM,1%,0.25W	91637	MFF1421G23201F
R4431	311-1265-00	B060000	B062419	RES.,VAR,NONWIR:2K OHM,10%,0.50W	32997	3329P-L58-202
R4431	----- -----			(1480C ONLY)		
R4431	311-1757-00	B062420		RES.,VAR,NONWIR:2.5K OHM,10%,0.50W	32997	3326H-G48-252
R4431	----- -----			(1480C ONLY)		
R4431	311-1265-00	B060000	B066447	RES.,VAR,NONWIR:2K OHM,10%,0.50W	32997	3329P-L58-202
R4431	----- -----			(1480R ONLY)		
R4431	311-1757-00	B066448		RES.,VAR,NONWIR:2.5K OHM,10%,0.50W	32997	3326H-G48-252
R4431	----- -----			(1480R ONLY)		

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
R4432	322-0335-00			RES.,FXD,FILM:30.1K OHM,1%,0.25W	91637	MFF1421G30101F
R4433	321-0314-00			RES.,FXD,FILM:18.2K OHM,1%,0.125W	91637	CMF55116G18201F
R4434	321-0308-00			RES.,FXD,FILM:15.8K OHM,1%,0.125W	91637	MFF1816G15801F
R4435	315-0201-00			RES.,FXD,CMPSN:200 OHM,5%,0.25W	57668	NTR25J-E200E
R4440	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	57668	NTR25J-E10K0
R4450	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	57668	NTR25J-E04K7
R4451	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	57668	NTR25J-E10K0
R4460	315-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.25W	57668	NTR25J-E 22K
R4470	315-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.25W	57668	NTR25J-E 22K
R4480	315-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.25W	57668	NTR25J-E 22K
R4481	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	57668	NTR25J-E10K0
R4493	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	57668	NTR25J-E 100E
R4500	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	57668	NTR25J-E 100E
R4501	303-0333-00			RES.,FXD,CMPSN:33K OHM,5%,1W	01121	GB3335
R4502	315-0220-00			RES.,FXD,CMPSN:22 OHM,5%,0.25W	57668	NTR25J-E 22E
R4503	315-0821-00			RES.,FXD,CMPSN:820 OHM,5%,0.25W	57668	NTR25J-E 820E
R4504	303-0333-00			RES.,FXD,CMPSN:33K OHM,5%,1W	01121	GB3335
R4510	321-0184-00			RES.,FXD,FILM:806 OHM,1%,0.125W	91637	CMF55116G806R0F
R4511	322-0353-00	B060000	B061962	RES.,FXD,FILM:46.4K OHM,1%,0.25W	91637	MFF1421G46401F
R4511	----- -----			(1480C ONLY)		
R4511	323-0354-00	B061963		RES.,FXD,FILM:47.5K OHM,1%,0.50W	75042	CECT0-4752F
R4511	----- -----			(1480C ONLY)		
R4511	322-0353-00	B060000	B065137	RES.,FXD,FILM:46.4K OHM,1%,0.25W	91637	MFF1421G46401F
R4511	----- -----			(1480R ONLY)		
R4511	323-0354-00	B065138		RES.,FXD,FILM:47.5K OHM,1%,0.50W	75042	CECT0-4752F
R4511	----- -----			(1480R ONLY)		
R4520	315-0222-00			RES.,FXD,CMPSN:2.2K OHM,5%,0.25W	57668	NTR25J-E02K2
R4521	321-0374-00			RES.,FXD,FILM:76.8K OHM,1%,0.125W	91637	MFF1816G76801F
R4522	321-0372-00			RES.,FXD,FILM:73.2K OHM,1%,0.125W	91637	MFF1816G73201F
R4527	321-0252-00			RES.,FXD,FILM:4.12K OHM,1%,0.125W	91637	MFF1816G41200F
R4531	321-0214-00			RES.,FXD,FILM:1.65K OHM,1%,0.125W	91637	MFF1816G16500F
R4532	311-0634-00			RES.,VAR,NONWIR:TRMR,500 OHM,0.5W	32997	3329H-L58-501
R4540	315-0752-00			RES.,FXD,CMPSN:7.5K OHM,5%,0.25W	57668	NTR25J-E07K5
R4550	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	57668	NTR25J-E10K0
R4560	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	57668	NTR25JE01K0
R4600	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	57668	NTR25J-E 100E
R4601	315-0220-00			RES.,FXD,CMPSN:22 OHM,5%,0.25W	57668	NTR25J-E 22E
R4612	322-0349-00			RES.,FXD,FILM:42.2K OHM,1%,0.25W	75042	CEBT0-4222F
R4613	321-0159-00	B060000	B062419	RES.,FXD,FILM:442 OHM,1%,0.125W	91637	CMF55116G442R0F
R4613	----- -----			(1480C ONLY)		
R4613	321-0152-00	B062420		RES.,FXD,FILM:374 OHM,1%,0.125W	91637	CMF55116G374R0F
R4613	----- -----			(1480C ONLY)		
R4613	321-0159-00	B060000	B066447	RES.,FXD,FILM:442 OHM,1%,0.125W	91637	CMF55116G442R0F
R4613	----- -----			(1480R ONLY)		
R4613	321-0152-00	B066448		RES.,FXD,FILM:374 OHM,1%,0.125W	91637	CMF55116G374R0F
R4613	----- -----			(1480R ONLY)		
R4621	315-0332-00			RES.,FXD,CMPSN:3.3K OHM,5%,0.25W	57668	NTR25J-E03K3
R4630	321-0209-00			RES.,FXD,FILM:1.47K OHM,1%,0.125W	91637	MFF1816G14700F
R4630	321-0209-00	B061355		RES.,FXD,FILM:1.47K OHM,1%,0.125W	91637	MFF1816G14700F
R4630	----- -----			(1481C,1482C,1485C ONLY)		
R4631	321-0209-00	B061355		RES.,FXD,FILM:1.47K OHM,1%,0.125W	91637	MFF1816G14700F
R4631	----- -----			(1481C,1482C,1485C ONLY)		

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
R4632	321-0183-00	B060000	B073470	RES.,FXD,FILM:787 OHM,1%,0.125W	91637	CMF55116G787R0F
R4632	----- -----			(1480C ONLY)		
R4632	321-0191-00	B073471		RES.,FXD,FILM:953 OHM,1%,0.125W	91637	CMF55116G953R0F
R4632	----- -----			(1480C ONLY)		
R4632	321-0183-00	B061355		RES.,FXD,FILM:787 OHM,1%,0.125W	91637	CMF55116G787R0F
R4632	----- -----			(1481C,1482C,1485C ONLY)		
R4632	321-0183-00	B060000	B089999	RES.,FXD,FILM:787 OHM,1%,0.125W	91637	CMF55116G787R0F
R4632	----- -----			(1480R ONLY)		
R4632	321-0191-00	B080000		RES.,FXD,FILM:953 OHM,1%,0.125W	91637	CMF55116G953R0F
R4632	----- -----			(1480R ONLY)		
R4633	315-0242-00			RES.,FXD,CMPSN:2.4K OHM,5%,0.25W	57668	NTR25J-E02K4
R4633	315-0242-00	B061355		RES.,FXD,CMPSN:2.4K OHM,5%,0.25W	57668	NTR25J-E02K4
R4633	----- -----			(1481C,1482C,1485C ONLY)		
R4642	315-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.25W	57668	NTR25J-E 22K
R4650	315-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.25W	57668	NTR25J-E 22K
R4662	315-0821-00			RES.,FXD,CMPSN:820 OHM,5%,0.25W	57668	NTR25J-E 820E
R4680	315-0431-00			RES.,FXD,CMPSN:430 OHM,5%,0.25W	57668	NTR25J-E 430E
R4690	315-0622-00			RES.,FXD,CMPSN:6.2K OHM,5%,0.25W	57668	NTR25J-E 6K2
R4700	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	57668	NTR25J-E10K0
R4701	321-0393-00			RES.,FXD,FILM:121K OHM,1%,0.125W	91637	CMF55116G12102F
R4701	----- -----			(END USAGE 670-3488-24 1480C/R,1481C/R		
R4701	----- -----			,1482C/R,1485C/R ONLY)		
R4701	321-0403-00			RES.,FXD,FILM:154K OHM,1%,0.125W	91637	MFF1816G15402F
R4701	----- -----			(BEGIN USAGE 670-3488-30 1480C/R,1481C/R		
R4701	----- -----			,1482C/R,1485C ONLY)		
R4702	315-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.25W	57668	NTR25J-E 22K
R4707	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	57668	NTR25J-E470E
R4708	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	57668	NTR25J-E470E
R4711	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	57668	NTR25JE01K0
R4712	321-0402-00			RES.,FXD,FILM:150K OHM,1%,0.125W	24546	NA55D1503F
R4713	321-0451-00			RES.,FXD,FILM:487K OHM,1%,0.125W	91637	CMF55116G48702F
R4719	321-0385-00			RES.,FXD,FILM:100K OHM,1%,0.125W	91637	MFF1816G10002F
R4720	315-0103-00	B061590		RES.,FXD,CMPSN:10K OHM,5%,0.25W	57668	NTR25J-E10K0
R4720	----- -----			(1480C ONLY)		
R4720	315-0103-00	B063830		RES.,FXD,CMPSN:10K OHM,5%,0.25W	57668	NTR25J-E10K0
R4720	----- -----			(1480R ONLY)		
R4721	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	57668	NTR25J-E 10E0
R4722	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	57668	NTR25J-E100K
R4723	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	57668	NTR25J-E10K0
R4724	315-0563-00			RES.,FXD,CMPSN:56K OHM,5%,0.25W	57668	NTR25J-E 56K
R4725	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	57668	NTR25JE01K0
R4730	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	57668	NTR25J-E10K0
R4731	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	57668	NTR25J-E04K7
R4732	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	57668	NTR25J-E47K0
R4735	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	57668	NTR25J-E47K0
R4750	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	57668	NTR25J-E04K7
R4751	315-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.25W	57668	NTR25J-E 22K
R4770	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	57668	NTR25JE01K0
R4780	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	57668	NTR25J-E10K0
R4781	315-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.25W	57668	NTR25J-E 22K
R4800	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	57668	NTR25J-E04K7
R4801	321-0318-00			RES.,FXD,FILM:20K OHM,1%,0.125W	91637	MFF1816G20001F

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R4802	321-0287-00	B060000	B073261	RES.,FXD,FILM:9.53K OHM,1%,0.125W	91637	MFF1816G95300F
R4802	----- -----			(1480C ONLY)		
R4802	321-0283-00	B073262		RES.,FXD,FILM:8.66K OHM,1%,0.125W	91637	CMF55116G86600F
R4802	----- -----			(1480C ONLY)		
R4802	321-0287-00	B060000	B079761	RES.,FXD,FILM:9.53K OHM,1%,0.125W	91637	MFF1816G95300F
R4802	----- -----			(1480R ONLY)		
R4802	321-0283-00	B079762		RES.,FXD,FILM:8.66K OHM,1%,0.125W	91637	CMF55116G86600F
R4802	----- -----			(1480R ONLY)		
R4803	315-0474-00	B060000	B073261	RES.,FXD,CMPSN:470K OHM,5%,0.25W	57668	NTR25J-E470K
R4803	----- -----			(1480C ONLY)		
R4803	321-0450-00	B073262		RES.,FXD,FILM:475K OHM,1%,0.125W	91637	CMF55116G47502F
R4803	----- -----			(1480C ONLY)		
R4803	315-0474-00	B060000	B079761	RES.,FXD,CMPSN:470K OHM,5%,0.25W	57668	NTR25J-E470K
R4803	----- -----			(1480R ONLY)		
R4803	321-0450-00	B079762		RES.,FXD,FILM:475K OHM,1%,0.125W	91637	CMF55116G47502F
R4803	----- -----			(1480R ONLY)		
R4810	315-0201-00			RES.,FXD,CMPSN:200 OHM,5%,0.25W	57668	NTR25J-E200E
R4819	315-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.25W	57668	NTR25J-E 22K
R4821	321-0181-00			RES.,FXD,FILM:750 OHM,1%,0.125W	91637	CMF55116G750R0F
R4822	315-0752-00			RES.,FXD,CMPSN:7.5K OHM,5%,0.25W	57668	NTR25J-E07K5
R4823	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	57668	NTR25J-E100K
R4824	315-0103-00	B061590		RES.,FXD,CMPSN:10K OHM,5%,0.25W	57668	NTR25J-E10K0
R4824	----- -----			(1480C ONLY)		
R4824	315-0103-00	B063830		RES.,FXD,CMPSN:10K OHM,5%,0.25W	57668	NTR25J-E10K0
R4824	----- -----			(1480R ONLY)		
R4830	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	57668	NTR25J-E10K0
R4840	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	57668	NTR25JE01K0
R4850	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	57668	NTR25J-E10K0
R4851	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	57668	NTR25JE01K0
R4852	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	57668	NTR25J-E04K7
R4860	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	57668	NTR25J-E04K7
R4880	315-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.25W	57668	NTR25J-E 22K
R4890	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	57668	NTR25J-E10K0
R4896	315-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.25W	57668	NTR25J-E 22K
R4900	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	57668	NTR25J-E 15K
R4900	----- -----			(OPTION 07 ONLY)		
R4910	321-0309-00			RES.,FXD,FILM:16.2K OHM,1%,0.125W,TC=TO	91637	CMF55116G16201F
R4910	----- -----			(OPTION 07 ONLY)		
R4911	321-0306-00			RES.,FXD,FILM:15K OHM,1%,0.125W	91637	MFF1816G15001F
R4911	----- -----			(OPTION 07 ONLY)		
R4920	321-0299-00			RES.,FXD,FILM:12.7K OHM,1%,0.125W	91637	MFF1816G12701F
R4920	----- -----			(OPTION 07 ONLY)		
R4921	315-0222-00			RES.,FXD,CMPSN:2.2K OHM,5%,0.25W	57668	NTR25J-E02K2
R4921	----- -----			(OPTION 07 ONLY)		
R4922	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	57668	NTR25J-E04K7
R4923	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	57668	NTR25J-E04K7
R4930	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	57668	NTR25J-E04K7
R4960	315-0332-00			RES.,FXD,CMPSN:3.3K OHM,5%,0.25W	57668	NTR25J-E03K3
R4970	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	57668	NTR255-E 1M
R4971	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	57668	NTR25J-E10K0
R4980	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	57668	NTR25J-E10K0
R4981	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	57668	NTR25J-E10K0
R4990	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	57668	NTR25J-E10K0
R4991	315-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.25W	57668	NTR25J-E 22K

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R5052	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	57668	NTR25JE01K0
R5062	315-0361-00			RES.,FXD,CMPSN:360 OHM,5%,0.25W	57668	NTR25J-E 360E
R5072	315-0222-00			RES.,FXD,CMPSN:2.2K OHM,5%,0.25W	57668	NTR25J-E02K2
R5074	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	57668	NTR25J-E100K
R6016	315-0681-00			RES.,FXD,CMPSN:680 OHM,5%,0.25W	57668	NTR25J-E680E
R6018	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	57668	NTR25J-E470E
R6032	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	57668	NTR25J-E04K7
R6034	315-0681-00			RES.,FXD,CMPSN:680 OHM,5%,0.25W	57668	NTR25J-E680E
R6036	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	57668	NTR25J-E 15K
R6038	308-0677-00			RES.,FXD,WW:1 OHM,5%,2W	75042	BWH-1R000J
R6042	315-0162-00			RES.,FXD,CMPSN:1.6K OHM,5%,0.25W	57668	NTR25J-E 1K6
R6046	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	57668	NTR25J-E100K
R6070	321-0200-00			RES.,FXD,FILM:1.18K OHM,1%,0.125W	91637	CMF55116G11800F
R6072	321-0150-00			RES.,FXD,FILM:357 OHM,1%,0.125W	91637	CMF55116G357R0F
R6076	321-0188-00			RES.,FXD,FILM:887 OHM,1%,0.125W	91637	CMF55116G887R0F
R6078	321-0173-00			RES.,FXD,FILM:619 OHM,1%,0.125W	91637	CMF55116G619R0F
R6082	315-0512-00			RES.,FXD,CMPSN:5.1K OHM,5%,0.25W	57668	NTR25J-E05K1
R6096	311-1228-00			RES.,VAR,NONWIR:10K OHM,20%,0.50W	32997	3386F-T04-103
R6116	315-0681-00			RES.,FXD,CMPSN:680 OHM,5%,0.25W	57668	NTR25J-E680E
R6118	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	57668	NTR25J-E470E
R6132	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	57668	NTR25J-E04K7
R6134	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	57668	NTR25J-E 15K
R6136	315-0681-00			RES.,FXD,CMPSN:680 OHM,5%,0.25W	57668	NTR25J-E680E
R6138	308-0677-00			RES.,FXD,WW:1 OHM,5%,2W	75042	BWH-1R000J
R6142	315-0162-00			RES.,FXD,CMPSN:1.6K OHM,5%,0.25W	57668	NTR25J-E 1K6
R6146	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	57668	NTR25J-E100K
R6164	311-1035-00			RES.,VAR,NONWIR:50K OHM,10%,0.50W	73138	82-40-0
R6172	321-0214-00			RES.,FXD,FILM:1.65K OHM,1%,0.125W	91637	MFF1816G16500F
R6174	321-0305-00			RES.,FXD,FILM:14.7K OHM,1%,0.125W	91637	MFF1816G14701F
R6176	315-0513-00			RES.,FXD,CMPSN:51K OHM,5%,0.25W	57668	NTR25J-E51K0
R6180	315-0220-00			RES.,FXD,CMPSN:22 OHM,5%,0.25W	57668	NTR25J-E 22E
R6182	321-0243-00			RES.,FXD,FILM:3.32K OHM,1%,0.125W	91637	MFF1816G33200F
R6184	321-0236-00			RES.,FXD,FILM:2.8K OHM,1%,0.125W	91637	MFF1816G28000F
R6216	315-0753-00			RES.,FXD,CMPSN:75K OHM,5%,0.25W	57668	NTR25J-E75K0
R6220	315-0562-00			RES.,FXD,CMPSN:5.6K OHM,5%,0.25W	57668	NTR25J-E05K6
R6225	308-0273-00			RES.,FXD,WW:6.5K OHM,2%,5W	91637	RS2A-65000G T/R
R6235	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	57668	NTR25JE01K0
R6242	308-0365-00			RES.,FXD,WW:1.5 OHM,5%,3W	91637	CW2B-1R500J T/R
R6246	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	57668	NTR25J-E 15K
R6252	315-0753-00			RES.,FXD,CMPSN:75K OHM,5%,0.25W	57668	NTR25J-E75K0
R6254	323-0347-00			RES.,FXD,FILM:40.2K OHM,1%,0.50W	75042	CECT0-4022F
R6264	321-0272-00			RES.,FXD,FILM:6.65K OHM,1%,0.125W	91637	MFF1816G66500F
R6266	315-0622-00			RES.,FXD,CMPSN:6.2K OHM,5%,0.25W	57668	NTR25J-E 6K2
R6272	321-0272-00			RES.,FXD,FILM:6.65K OHM,1%,0.125W	91637	MFF1816G66500F
R6276	321-0347-00			RES.,FXD,FILM:40.2K OHM,1%,0.125W	91637	CMF55116C40201F
R6314	315-0122-00			RES.,FXD,CMPSN:1.2K OHM,5%,0.25W	57668	NTR25J-E01K2
R6316	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	57668	NTR25JE01K0
R6318	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	57668	NTR25J-E 10E0
R6320	308-0273-00			RES.,FXD,WW:6.5K OHM,2%,5W	91637	RS2A-65000G T/R
R6322	315-0562-00			RES.,FXD,CMPSN:5.6K OHM,5%,0.25W	57668	NTR25J-E05K6
R6332	323-0327-00			RES.,FXD,FILM:24.9K OHM,1%,0.50W	91637	MFF1226G24901F
R6338	323-0322-00			RES.,FXD,FILM:22.1K OHM,1%,0.50W	75042	CECT0-2212F
R6360	315-0134-00			RES.,FXD,CMPSN:130K OHM,5%,0.25W	57668	NTR25J-E130K
R6414	311-1227-00			RES.,VAR,NONWIR:5K OHM,20%,0.50W	32997	3386F-T04-502

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R6426	315-0152-00			RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	57668	NTR25J-E01K5
R6429	315-0472-00	B060000	B073779	RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	57668	NTR25J-E04K7
R6429	----- -----			(1480C ONLY)		
R6429	315-0302-00	B073780		RES.,FXD,CMPSN:3K OHM,5%,0.25W	57668	NTR25J-E03K0
R6429	----- -----			(1480C ONLY)		
R6429	315-0472-00	B060000	B082679	RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	57668	NTR25J-E04K7
R6429	----- -----			(1480R ONLY)		
R6429	315-0302-00	B082680		RES.,FXD,CMPSN:3K OHM,5%,0.25W	57668	NTR25J-E03K0
R6429	----- -----			(1480R ONLY)		
R6434	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	57668	NTR25J-E470E
R6436	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	57668	NTR25J-E100K
R6440	315-0224-00			RES.,FXD,CMPSN:220K OHM,5%,0.25W	57668	NTR25J-E220K
R6442	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	57668	NTR25J-E 100E
R6444	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	57668	NTR25JE01K0
R6448	317-0104-00	B073694		RES.,FXD,CMPSN:100K OHM,5%,0.125W	01121	BB1045
R6448	----- -----			(1480C ONLY)		
R6448	317-0104-00	B081954		RES.,FXD,CMPSN:100K OHM,5%,0.125W	01121	BB1045
R6448	----- -----			(1480R ONLY)		
R6450	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	57668	NTR25J-E10K0
R6460	315-0392-00			RES.,FXD,CMPSN:3.9K OHM,5%,0.25W	57668	NTR25J-E03K9
R6462	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	57668	NTR25J-E470E
R6464	315-0752-00			RES.,FXD,CMPSN:7.5K OHM,5%,0.25W	57668	NTR25J-E07K5
R6465	315-0273-00			RES.,FXD,CMPSN:27K OHM,5%,0.25W	57668	NTR25J-E27K0
R6466	311-1225-00			RES.,VAR,NONWIR:1K OHM,20%,0.50W	32997	3386F-T04-102
R6468	315-0392-00			RES.,FXD,CMPSN:3.9K OHM,5%,0.25W	57668	NTR25J-E03K9
R6482	315-0392-00			RES.,FXD,CMPSN:3.9K OHM,5%,0.25W	57668	NTR25J-E03K9
R6484	315-0123-00			RES.,FXD,CMPSN:12K OHM,5%,0.25W	57668	NTR25J-E12K0
R6486	315-0513-00			RES.,FXD,CMPSN:51K OHM,5%,0.25W	57668	NTR25J-E51K0
R6503	311-1235-00			RES.,VAR,NONWIR:100K OHM,20%,0.50W	32997	3386F-T04-104
R6508	311-1235-00			RES.,VAR,NONWIR:100K OHM,20%,0.50W	32997	3386F-T04-104
R6524	315-0303-00	B060000	B073779	RES.,FXD,CMPSN:30K OHM,5%,0.25W	57668	NTR25J-E 30K
R6524	----- -----			(1480C ONLY)		
R6524	301-0203-00	B073780		RES.,FXD,CMPSN:20K OHM,5%,0.5W	57668	TR50J-E20K
R6524	----- -----			(1480C ONLY)		
R6524	315-0303-00	B060000	B082679	RES.,FXD,CMPSN:30K OHM,5%,0.25W	57668	NTR25J-E 30K
R6524	----- -----			(1480R ONLY)		
R6524	301-0203-00	B082680		RES.,FXD,CMPSN:20K OHM,5%,0.5W	57668	TR50J-E20K
R6524	----- -----			(1480R ONLY)		
R6526	321-0197-00			RES.,FXD,FILM:1.1K OHM,1%,0.125W	91637	CMF55116G11000F
R6532	321-0234-00			RES.,FXD,FILM:2.67K OHM,1%,0.125W	91637	MFF1816G26700F
R6534	321-0251-00			RES.,FXD,FILM:4.02K OHM,1%,0.125W	91637	MFF1816G40200F
R6536	315-0272-00			RES.,FXD,CMPSN:2.7K OHM,5%,0.25W	57668	NTR25J-E02K7
R6540	311-1261-00			RES.,VAR,NONWIR:500 OHM,10%,0.50W	32997	3329P-L58-501
R6546	315-0683-00			RES.,FXD,CMPSN:68K OHM,5%,0.25W	57668	NTR25J-E68K0
R6550	301-0275-00			RES.,FXD,CMPSN:2.7M OHM,5%,0.5W	01121	EB2755
R6566	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	57668	NTR25JE01K0
R6570	315-0432-00			RES.,FXD,CMPSN:4.3K OHM,5%,0.25W	57668	NTR25J-E04K3
R6572	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	57668	NTR25J-E10K0
R6574	323-0312-00			RES.,FXD,FILM:17.4K OHM,1%,0.50W	91637	MFF1226G17401F
R6576	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	57668	NTR25J-E04K7
R6578	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	57668	NTR25J-E 15K
R6580	315-0203-00			RES.,FXD,CMPSN:20K OHM,5%,0.25W	57668	NTR25J-E20K0
R6582	315-0203-00			RES.,FXD,CMPSN:20K OHM,5%,0.25W	57668	NTR25J-E20K0
R6584	315-0513-00			RES.,FXD,CMPSN:51K OHM,5%,0.25W	57668	NTR25J-E51K0

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R6586	315-0273-00			RES.,FXD,CMPSN:27K OHM,5%,0.25W	57668	NTR25J-E27K0
R6618	315-0512-00			RES.,FXD,CMPSN:5.1K OHM,5%,0.25W	57668	NTR25J-E05K1
R6619	315-0512-00			RES.,FXD,CMPSN:5.1K OHM,5%,0.25W	57668	NTR25J-E05K1
R6660	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	57668	NTR25JE01K0
R6664	303-0203-00			RES.,FXD,CMPSN:20K OHM,5%,1W	01121	GB2035
R6672	315-0562-00			RES.,FXD,CMPSN:5.6K OHM,5%,0.25W	57668	NTR25J-E05K6
R6674	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	57668	NTR25J-E 10E0
R6676	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	57668	NTR25J-E04K7
R6680	311-1232-00			RES.,VAR,NONWIR:50K OHM,20%,0.50W	32997	3386F-T04-503
R6682	315-0122-00	B060000	B073458	RES.,FXD,CMPSN:1.2K OHM,5%,0.25W	57668	NTR25J-E01K2
R6682	----- -----			(1480C ONLY)		
R6682	315-0221-00	B073459		RES.,FXD,CMPSN:220 OHM,5%,0.25W	57668	NTR25J-E220E
R6682	----- -----			(1480C ONLY)		
R6682	315-0122-00	B060000	B080964	RES.,FXD,CMPSN:1.2K OHM,5%,0.25W	57668	NTR25J-E01K2
R6682	----- -----			(1480R ONLY)		
R6682	315-0221-00	B080965		RES.,FXD,CMPSN:220 OHM,5%,0.25W	57668	NTR25J-E220E
R6682	----- -----			(1480R ONLY)		
R6684	315-0121-00			RES.,FXD,CMPSN:120 OHM,5%,0.25W	57668	NTR25J-E 120E
R6718	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	57668	NTR25J-E 15K
R6728	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	57668	NTR25J-E 10E0
R6754	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	57668	NTR255-E 1M
R6788	315-0272-03			RES.,FXD,CMPSN:2.7K OHM,5%,0.25W	01121	CB2725
R6860	307-0414-00			RES.,FXD,FILM:HIGH VOLTAGE REGULATOR	80009	307-0414-00
R6885	301-0102-00	B060000	B073291	RES.,FXD,CMPSN:1K OHM,5%,0.50W	01121	EB1025
R6885	----- -----			(1480C ONLY)		
R6885	301-0102-03	B073292		RES.,FXD,CMPSN:1K OHM,5%,0.5W	01121	EB1025
R6885	----- -----			(1480C ONLY)		
R6885	301-0102-00	B060000	B080368	RES.,FXD,CMPSN:1K OHM,5%,0.50W	01121	EB1025
R6885	----- -----			(1480R ONLY)		
R6885	301-0102-03	B080369		RES.,FXD,CMPSN:1K OHM,5%,0.5W	01121	EB1025
R6885	----- -----			(1480R ONLY)		
R6885	301-0102-00	B060000	B073384	RES.,FXD,CMPSN:1K OHM,5%,0.50W	01121	EB1025
R6885	----- -----			(1481C ONLY)		
R6885	301-0102-03	B073385		RES.,FXD,CMPSN:1K OHM,5%,0.5W	01121	EB1025
R6885	----- -----			(1481C ONLY)		
R6885	301-0102-00	B060000	B080369	RES.,FXD,CMPSN:1K OHM,5%,0.50W	01121	EB1025
R6885	----- -----			(1481R ONLY)		
R6885	301-0102-03	B080370		RES.,FXD,CMPSN:1K OHM,5%,0.5W	01121	EB1025
R6885	----- -----			(1481R ONLY)		
R6885	301-0102-03			RES.,FXD,CMPSN:1K OHM,5%,0.5W	01121	EB1025
R6885	----- -----			(1482C ONLY)		
R6885	301-0102-00	B060000	B080358	RES.,FXD,CMPSN:1K OHM,5%,0.50W	01121	EB1025
R6885	----- -----			(1482R ONLY)		
R6885	301-0102-03	B080359		RES.,FXD,CMPSN:1K OHM,5%,0.5W	01121	EB1025
R6885	----- -----			(1482R ONLY)		
R6885	301-0102-00	B060000	B073367	RES.,FXD,CMPSN:1K OHM,5%,0.50W	01121	EB1025
R6885	----- -----			(1485C ONLY)		
R6885	301-0102-03	B073368		RES.,FXD,CMPSN:1K OHM,5%,0.5W	01121	EB1025
R6885	----- -----			(1485C ONLY)		
R6885	301-0102-00	B060000	B080377	RES.,FXD,CMPSN:1K OHM,5%,0.50W	01121	EB1025
R6885	----- -----			(1485R ONLY)		
R6885	301-0102-03	B080378		RES.,FXD,CMPSN:1K OHM,5%,0.5W	01121	EB1025
R6885	----- -----			(1485R ONLY)		
R6888	315-0272-03			RES.,FXD,CMPSN:2.7K OHM,5%,0.25W	01121	CB2725

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R6892	315-0272-03			RES.,FXD,CMPSN:2.7K OHM,5%,0.25W	01121	CB2725
R6942	315-0271-03			RES.,FXD CMPSN:270 OHM,5%,0.25W	01121	CB2715
R6944	315-0182-03			RES.,FXD,CMPSN:1.8K OHM,5%,0.25W	01121	CB1825
R6946	315-0203-02			RES.,FXD,CMPSN:20K OHM,5%,0.25W	01121	CB2035
R6947	315-0120-00	B060000	B073693	RES.,FXD,CMPSN:12 OHM,5%,0.25W	57668	NTR25J-R12
R6947	----- -----			(1480C ONLY)		
R6947	301-0150-00	B073694		RES.,FXD,CMPSN:15 OHM,5%,0.5W	01121	EB1505
R6947	----- -----			(1480C ONLY)		
R6947	315-0120-00	B060000	B081953	RES.,FXD,CMPSN:12 OHM,5%,0.25W	57668	NTR25J-R12
R6947	----- -----			(1480R ONLY)		
R6947	301-0150-00	B081954		RES.,FXD,CMPSN:15 OHM,5%,0.5W	01121	EB1505
R6947	----- -----			(1480R ONLY)		
R6952	315-0182-03			RES.,FXD,CMPSN:1.8K OHM,5%,0.25W	01121	CB1825
R6954	315-0511-02			RES.,FXD,CMPSN:510 OHM,5%,0.25W	01121	CB5115
R6958	315-0915-02			RES.,FXD,CMPSN:9.1M OHM,5%,0.25W	01121	CB9155
R7103	315-0152-00			RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	57668	NTR25J-E01K5
R7103	----- -----			(OPTION 04 ONLY)		
R7105	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	57668	NTR25J-E04K7
R7105	----- -----			(OPTION 04 ONLY)		
R7107	315-0332-00			RES.,FXD,CMPSN:3.3K OHM,5%,0.25W	57668	NTR25J-E03K3
R7107	----- -----			(OPTION 04 ONLY)		
R7112	315-0132-00			RES.,FXD,CMPSN:1.3K OHM,5%,0.25W	57668	NTR25J-E01K3
R7112	----- -----			(OPTION 04 ONLY)		
R7120	315-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.25W	57668	NTR25J-E 22K
R7120	----- -----			(OPTION 04 ONLY)		
R7130	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	57668	NTR25J-E10K0
R7130	----- -----			(OPTION 04 ONLY)		
R7140	315-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.25W	57668	NTR25J-E02K0
R7140	----- -----			(OPTION 04 ONLY)		
R7150	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	57668	NTR25J-E04K7
R7150	----- -----			(OPTION 04 ONLY)		
R7180	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	57668	NTR25J-E 15K
R7180	----- -----			(OPTION 04 ONLY)		
R7185	315-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.25W	57668	NTR25J-E 22K
R7185	----- -----			(OPTION 04 ONLY)		
R7196	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	57668	NTR25J-E 15K
R7196	----- -----			(OPTION 04 ONLY)		
R7199	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	57668	NTR25J-E 15K
R7199	----- -----			(OPTION 04 ONLY)		
R7260	315-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.25W	57668	NTR25J-E 22K
R7260	----- -----			(OPTION 04 ONLY)		
R8003	315-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.25W	57668	NTR25J-E 22K
R8003	----- -----			(1482 ONLY)		
R8015	315-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.25W	57668	NTR25J-E 22K
R8015	----- -----			(1482 ONLY)		
R8030	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	57668	NTR25J-E100K
R8030	----- -----			(1482 ONLY)		
R8031	315-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.25W	57668	NTR25J-E 22K
R8031	----- -----			(1482 ONLY)		
R8039	315-0622-00			RES.,FXD,CMPSN:6.2K OHM,5%,0.25W	57668	NTR25J-E 6K2
R8039	----- -----			(1482 ONLY)		
R9030	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	57668	NTR25J-E 10E0
R9409	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	57668	NTR25J-E10K0
R9409	----- -----			(OPTION 07 ONLY)		

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R9412	321-0370-00			RES.,FXD,FILM:69.8K OHM,1%,0.125W	91637	MFF1816G69801F
R9412	----- -----			(OPTION 07 ONLY)		
R9413	321-0297-00			RES.,FXD,FILM:12.1K OHM,1%,0.125W	91637	MFF1816G12101F
R9413	----- -----			(OPTION 07 ONLY)		
R9414	315-0822-00			RES.,FXD,CMPSN:8.2K OHM,5%,0.25W	57668	NTR25J-E 8K2
R9414	----- -----			(OPTION 07 ONLY)		
R9416	321-0261-00			RES.,FXD,FILM:5.11K OHM,1%,0.125W	91637	MFF1816G51100F
R9416	----- -----			(OPTION 07 ONLY)		
R9417	321-0215-00			RES.,FXD,FILM:1.69K OHM,1%,0.125W	91637	MFF1816G16900F
R9417	----- -----			(OPTION 07 ONLY)		
R9418	315-0822-00			RES.,FXD,CMPSN:8.2K OHM,5%,0.25W	57668	NTR25J-E 8K2
R9418	----- -----			(OPTION 07 ONLY)		
R9419	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	57668	NTR25J-E10K0
R9419	----- -----			(OPTION 07 ONLY)		
R9420	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	57668	NTR25J-E 100E
R9420	----- -----			(OPTION 07 ONLY)		
R9422	315-0752-00			RES.,FXD,CMPSN:7.5K OHM,5%,0.25W	57668	NTR25J-E07K5
R9422	----- -----			(OPTION 07 ONLY)		
R9424	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	57668	NTR25J-E04K7
R9424	----- -----			(OPTION 07 ONLY)		
R9425	315-0222-00			RES.,FXD,CMPSN:2.2K OHM,5%,0.25W	57668	NTR25J-E02K2
R9425	----- -----			(OPTION 07 ONLY)		
R9427	315-0564-00			RES.,FXD,CMPSN:560K OHM,5%,0.25W	57668	NTR25J-E 560K
R9427	----- -----			(OPTION 07 ONLY)		
R9429	321-0244-00			RES.,FXD,FILM:3.4K OHM,1%,0.125W	24546	CT553401F
R9429	----- -----			(OPTION 07 ONLY)		
R9432	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	57668	NTR25J-E100K
R9432	----- -----			(OPTION 07 ONLY)		
R9436	321-0354-00			RES.,FXD,FILM:47.5K OHM,1%,0.125W	91637	CMF55116G47501F
R9436	----- -----			(OPTION 07 ONLY)		
R9439	315-0394-00			RES.,FXD,CMPSN:390K OHM,5%,0.25W	57668	NTR25J-E390K
R9439	----- -----			(OPTION 07 ONLY)		
R9441	315-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.25W	57668	NTR25J-E 22K
R9441	----- -----			(OPTION 07 ONLY)		
R9442	315-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.25W	57668	NTR25J-E 22K
R9442	----- -----			(OPTION 07 ONLY)		
R9443	315-0915-00			RES.,FXD,CMPSN:9.1M OHM,5%,0.25W	01121	CB9155
R9443	----- -----			(OPTION 07 ONLY)		
R9445	315-0564-00			RES.,FXD,CMPSN:560K OHM,5%,0.25W	57668	NTR25J-E 560K
R9445	----- -----			(OPTION 07 ONLY)		
R9446	321-0337-00			RES.,FXD,FILM:31.6K OHM,1%,0.125W	91637	MFF1816G31601F
R9446	----- -----			(OPTION 07 ONLY)		
R9447	315-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.25W	57668	NTR25J-E 22K
R9447	----- -----			(OPTION 07 ONLY)		
R9449	315-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.25W	57668	NTR25J-E 22K
R9449	----- -----			(OPTION 07 ONLY)		
R9451	315-0751-00			RES.,FXD,CMPSN:750 OHM,5%,0.25W	57668	NTR25J-E750E
R9451	----- -----			(OPTION 07 ONLY)		
R9453	315-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.25W	57668	NTR25J-E 22K
R9453	----- -----			(OPTION 07 ONLY)		
R9455	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	57668	NTR25J-E 15K
R9455	----- -----			(OPTION 07 ONLY)		
R9456	315-0303-00			RES.,FXD,CMPSN:30K OHM,5%,0.25W	57668	NTR25J-E 30K
R9456	----- -----			(OPTION 07 ONLY)		

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R9457	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	57668	NTR25J-E 15K
R9457	----- -----			(OPTION 07 ONLY)		
R9821	321-0085-00			RES.,FXD,FILM:75 OHM,1%,0.125W	91637	CMF55116G75R00F
R9822	321-0114-00			RES.,FXD,FILM:150 OHM,1%,0.125W	91637	CMF55116G150R0F
R9828	311-1804-00			RES.,VAR,NONWIR:500 OHM,10%,1W	01121	15M848
R9828	----- -----			(PART OF S9820)		
R9880	311-1524-00			RES.,VAR,NONWIR:20K OHM,10%,1W	01121	73A1G040L203U
R9882	311-0254-00			RES.,VAR,NONWIR:5M OHM,10%,1W	12697	CM29709
R9891	311-0306-00	B060000	B061464	RES.,VAR,NONWIR:2.5M OHM,0.50W	12697	CM3093L
R9891	----- -----			(1480C ONLY)		
R9891	311-1991-00	B061465		RES.,VAR,NONWIR:CKT BD,2.5M OHM,20%,1W	12697	MODEL 381
R9891	----- -----			(1480C ONLY)		
R9891	311-0306-00	B060000	B063814	RES.,VAR,NONWIR:2.5M OHM,0.50W	12697	CM3093L
R9891	----- -----			(1480R ONLY)		
R9891	311-1991-00	B063815		RES.,VAR,NONWIR:CKT BD,2.5M OHM,20%,1W	12697	MODEL 381
R9891	----- -----			(1480R ONLY)		
R9892	311-1929-00	B061355	B073470	RES.,VAR,NONWIR:PNL,1K OHM,1W,LINEAR	01121	ORD BY DESCR
R9892	----- -----			(PART OF S9892)		
R9892	----- -----			1481C,1482C 1485C ONLY)		
R9892	311-2170-00	B073471		RES.,VAR,NONWIR:PNL,1K OHM,10%,0.5W	01121	25M816
R9892	----- -----			(PART OF S9892)		
R9892	----- -----			(1481C,1482C 1485C ONLY)		
R9892	311-1929-00	B060000	B080999	RES.,VAR,NONWIR:PNL,1K OHM,1W,LINEAR	01121	ORD BY DESCR
R9892	----- -----			(1481R,1482R 1485R ONLY)		
R9892	311-2170-00	B081000		RES.,VAR,NONWIR:PNL,1K OHM,10%,0.5W	01121	25M816
R9892	----- -----			(1481R,1482R 1485R ONLY)		
R9894	315-0361-00	B061355		RES.,FXD,CMPSN:360 OHM,5%,0.25W	57668	NTR25J-E 360E
R9894	----- -----			(1481C,1482C 1485C ONLY)		
R9894	315-0361-00			RES.,FXD,CMPSN:360 OHM,5%,0.25W	57668	NTR25J-E 360E
R9894	----- -----			(1481R,1482R 1485R ONLY)		
R9920	311-0095-00			RES.,VAR,NONWIR:500 OHM,10%	12697	CM39788
R9920	----- -----			(OPTION 01 ONLY)		
R9925	311-1057-00			RES.,VAR,NONWIR:5K OHM,3%,0.0 1%	32997	3540S-420-502
R9935	311-0310-00			RES.,VAR,NONWIR:5K OHM,20%,0.50W	01121	W-7350A
R9940	311-0169-00			RES.,VAR,NONWIR:100 OHM,20%,0.50W	01121	W-7564B
R9980	311-1310-00			RES.,VAR,NONWIR:20K OHM,20%,1W	01121	10M654
R9980	----- -----			(PART OF S9980)		
R9982	311-1704-00			RES.,VAR,NONWIR:10K X 10K OHM,20%,0.50W	01121	17M599
R9982	----- -----			(PART OF R9983,S9982)		
R9983	311-1704-00			RES.,VAR,NONWIR:10K X 10K OHM,20%,0.50W	01121	17M599
R9983	----- -----			(PART OF R9982,S9982)		
R9984	315-0361-00			RES.,FXD,CMPSN:360 OHM,5%,0.25W	57668	NTR25J-E 360E
R9990	311-1057-00			RES.,VAR,NONWIR:5K OHM,3%,0.0 1%	32997	3540S-420-502
R9992	311-1705-00	B060000	B073159	RES.,VAR,WW:PNL,10K OHM,2W	73138	7266-397-00
R9992	----- -----			(1480C ONLY)		
R9992	311-1705-01	B073160		RES.,VAR,WW:PNL,10K OHM,5%,2.0W	73138	7281-225-0
R9992	----- -----			(1480C ONLY)		
R9992	311-1705-00	B060000	B079129	RES.,VAR,WW:PNL,10K OHM,2W	73138	7266-397-00
R9992	----- -----			(1480R ONLY)		
R9992	311-1705-01	B079130		RES.,VAR,WW:PNL,10K OHM,5%,2.0W	73138	7281-225-0
R9992	----- -----			(1480R ONLY)		

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S2210	260-1676-00	B060000	B061819	SWITCH,PUSH:7 STA,2 POLE,INTERLOCK	80009	260-1676-00
S2210	----- -----			(1480C ONLY)		
S2220	----- -----			(PART OF S2210)		
S2230	----- -----			(PART OF S2210)		
S2250	----- -----			(PART OF S2210)		
S2255	----- -----			(PART OF S2210)		
S2270	----- -----			(PART OF S2210)		
S2280	----- -----			(PART OF S2210)		
S2210	260-1676-01	B061820		SWITCH,PUSH:7 STA,2 POLE,VERTICAL	59821	ORD BY DESCR
S2210	----- -----			(1480C ONLY)		
S2220	----- -----			(PART OF S2210)		
S2230	----- -----			(PART OF S2210)		
S2250	----- -----			(PART OF S2210)		
S2255	----- -----			(PART OF S2210)		
S2270	----- -----			(PART OF S2210)		
S2280	----- -----			(PART OF S2210)		
S2210	260-1676-00	B060000	B064489	SWITCH,PUSH:7 STA,2 POLE,INTERLOCK	80009	260-1676-00
S2210	----- -----			(1480R ONLY)		
S2220	----- -----			(PART OF S2210)		
S2230	----- -----			(PART OF S2210)		
S2250	----- -----			(PART OF S2210)		
S2255	----- -----			(PART OF S2210)		
S2270	----- -----			(PART OF S2210)		
S2280	----- -----			(PART OF S2210)		
S2210	260-1676-01	B064490		SWITCH,PUSH:7 STA,2 POLE,VERTICAL	59821	ORD BY DESCR
S2210	----- -----			(1480R ONLY)		
S2220	----- -----			(PART OF S2210)		
S2230	----- -----			(PART OF S2210)		
S2250	----- -----			(PART OF S2210)		
S2255	----- -----			(PART OF S2210)		
S2270	----- -----			(PART OF S2210)		
S2280	----- -----			(PART OF S2210)		
S5001	260-1674-00	B060000	B061551	SWITCH,PUSH:6 STA,2 POLE,INTERLOCK	80009	260-1674-00
S5001	----- -----			(1480C ONLY)		
S5001	260-1674-01	B061552		SWITCH,PUSH:6 STA,2 POLE,HORIZ BOTTOM	80009	260-1674-01
S5001	----- -----			(1480C ONLY)		
S5001	260-1674-00	B060000	B063727	SWITCH,PUSH:6 STA,2 POLE,INTERLOCK	80009	260-1674-00
S5001	----- -----			(1480R ONLY)		
S5001	260-1674-01	B063728		SWITCH,PUSH:6 STA,2 POLE,HORIZ BOTTOM	80009	260-1674-01
S5001	----- -----			(1480R ONLY)		
S5006	260-1675-00	B060000	B061551	SWITCH,PUSH:8 STA,2 POLE,INTERLOCK	80009	260-1675-00
S5006	----- -----			(1480C ONLY)		
S5006	260-1675-01	B061552		SWITCH,PUSH:8 STA,2 POLE,HORIZ TOP	80009	260-1675-01
S5006	----- -----			(1480C ONLY)		
S5006	260-1675-00	B060000	B063727	SWITCH,PUSH:8 STA,2 POLE,INTERLOCK	80009	260-1675-00
S5006	----- -----			(1480R ONLY)		
S5006	260-1675-01	B063728		SWITCH,PUSH:8 STA,2 POLE,HORIZ TOP	80009	260-1675-01
S5006	----- -----			(1480R ONLY)		
S5016	----- -----			(PART OF S5006)		
S5026	----- -----			(PART OF S5006)		
S5036	----- -----			(PART OF S5006)		
S5041	----- -----			(PART OF S5006)		
S5056	----- -----			(PART OF S5006)		
S5071	----- -----			(PART OF S5006)		

	Tektronix	Serial/Model No.			Mfr	
Ckt No.	Part No.	Eff	Dscont	Name & Description	Code	Mfr Part Number
S5076	----- -----			(PART OF S5006)		
S5086	----- -----			(PART OF S5006)		
S5096	----- -----			(PART OF S5006)		
S9190	260-0675-00			SWITCH,SLIDE:DPDT,W/O DETENTS	82389	11A1024
S9815	260-1679-00			SWITCH,ROTARY:	80009	260-1679-00
S9820	311-1804-00			RES.,VAR,NONWIR:500 OHM,10%,1W	01121	15M848
S9820	----- -----			(PART OF R9828)		
S9828	260-1677-00			SWITCH,ROTARY:	80009	260-1677-00
S9836	260-0276-00	B060000	B061654	SWITCH,TOGGLE:DPST,15A,125V	27193	7561 K 4
S9836	----- -----			(1480C ONLY)		
S9836	260-1921-00	B061655		SWITCH,TOGGLE:DPDT,10A,125VAC	09353	9221TZ40
S9836	----- -----			(1480C ONLY)		
S9836	260-0276-00	B060000	B063951	SWITCH,TOGGLE:DPST,15A,125V	27193	7561 K 4
S9836	----- -----			(1480R ONLY)		
S9836	260-1921-00	B063952		SWITCH,TOGGLE:DPDT,10A,125VAC	09353	9221TZ40
S9836	----- -----			(1480R ONLY)		
S9890	260-1681-00			SWITCH,ROTARY:	80009	260-1681-00
S9891	260-1680-00			SWITCH,ROTARY:	80009	260-1680-00
S9892	311-1929-00			RES.,VAR,NONWIR:PNL,1K OHM,1W,LINEAR	01121	ORD BY DESCR
S9892	----- -----			(PART OF R9892)		
S9892	311-1929-00	B061355		RES.,VAR,NONWIR:PNL,1K OHM,1W,LINEAR	01121	ORD BY DESCR
S9892	----- -----			(PART OF R9892)		
S9892	----- -----			1481C,1482C,1485C ONLY)		
S9915	260-1682-00			SWITCH,ROTARY:	80009	260-1682-00
S9955	260-1648-00			SWITCH,SLIDE:0.5A,125VAC	79727	G-128-L
S9980	311-1310-00			RES.,VAR,NONWIR:20K OHM,20%,1W	01121	10M654
S9980	----- -----			(PART OF R9980)		
S9982	311-1704-00			RES.,VAR,NONWIR:10K X 10K OHM,20%,0.50W	01121	17M599
S9982	----- -----			(PART OF R9982 AND R9983)		
S9992	260-1678-00	B060000	B073159	SWITCH,ROTARY:	80009	260-1678-00
S9992	----- -----			(1480C ONLY)		
S9992	260-1678-01	B073160		SWITCH,ROTARY:DIGITAL LINE SELECTOR	80009	260-1678-01
S9992	----- -----			(1480C ONLY)		
S9992	260-1678-00	B060000	B079129	SWITCH,ROTARY:	80009	260-1678-00
S9992	----- -----			(1480R ONLY)		
S9992	260-1678-01	B079130		SWITCH,ROTARY:DIGITAL LINE SELECTOR	80009	260-1678-01
S9992	----- -----			(1480R ONLY)		
T6810	120-0948-00	B060000	B073693	XFMR,PWR,STU:HV	80009	120-0948-00
T6810	----- -----			(1480C ONLY)		
T6810	120-0948-01	B073694		XFMR,PWR,STU:HV	80009	120-0948-00
T6810	----- -----			(1480C ONLY)		
T6810	120-0948-00	B060000	B081953	XFMR,PWR,STU:HV	80009	120-0948-00
T6810	----- -----			(1480R ONLY)		
T6810	120-0948-01	B081954		XFMR,PWR,STU:HV	80009	120-0948-00
T6810	----- -----			(1480R ONLY)		
T9400	120-0949-00			XFMR,PWR,SDN&SU:	80009	120-0949-00
U1223	156-0067-00	B060000	B061850	MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	04713	MC1741CP1
U1223	----- -----			(1480C ONLY)		
U1223	156-0067-11	B061851		MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	02735	CA741CE
U1223	----- -----			(1480C ONLY)		
U1223	156-0067-00	B060000	B064673	MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	04713	MC1741CP1
U1223	----- -----			(1480R ONLY)		
U1223	156-0067-11	B064674		MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	02735	CA741CE
U1223	----- -----			(1480R ONLY)		

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
U1347	156-0355-00			MICROCIRCUIT,LI:7-XSTR,COMMON EMITTER	02735	CA3081
U1820	156-0067-00	B060000	B073693	MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	04713	MC1741CP1
U1820	----- -----			(1480C ONLY)		
U1820	156-0067-13	B073694		MICROCIRCUIT,LI:OPNL AMPL,SELECTED	01295	UA741CJG4
U1820	----- -----			(1480C ONLY)		
U1820	156-0067-00	B060000	B081953	MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	04713	MC1741CP1
U1820	----- -----			(1480R ONLY		
U1820	156-0067-13	B081954		MICROCIRCUIT,LI:OPNL AMPL,SELECTED	01295	UA741CJG4
U1820	----- -----			(1480R ONLY)		
U1890	156-0356-00	B060000	B062556	MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	80009	156-0356-00
U1890	----- -----			(1480C ONLY)		
U1890	156-0356-01	B062557		MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	02735	CA3080TX
U1890	----- -----			(1480C ONLY)		
U1890	156-0356-00	B060000	B067570	MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	80009	156-0356-00
U1890	----- -----			(1480R ONLY)		
U1890	156-0356-01	B067571		MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	02735	CA3080TX
U1890	----- -----			(1480R ONLY)		
U3040	156-0030-03			MICROCIRCUIT,DI:QUAD 2-INP NAND GATE,SCRN	01295	SN7400(NP3 OR JP
U3070	156-0487-02			MICROCIRCUIT,DI:DUAL RETRIGGERABLE MONO MV	07263	96L02
U3120	156-0158-00	B060000	B061408	MICROCIRCUIT,LI:DUAL OPERATIONAL AMPLIFIER	18324	MC1458N
U3120	----- -----			(1480C ONLY)		
U3120	156-0158-05	B061409	B073690	MICROCIRCUIT,LI:DUAL OPERATIONAL AMPLIFIER	80009	156-0158-05
U3120	----- -----			(1480C ONLY)		
U3120	156-0158-07	B073691		MICROCIRCUIT,LI:DUAL OPNL AMPL,SCREENED	01295	MC1458JG4
U3120	----- -----			(1480C ONLY)		
U3120	156-0158-00	B060000	B063359	MICROCIRCUIT,LI:DUAL OPERATIONAL AMPLIFIER	18324	MC1458N
U3120	----- -----			(1480R ONLY)		
U3120	156-0158-05	B063360	B082029	MICROCIRCUIT,LI:DUAL OPERATIONAL AMPLIFIER	80009	156-0158-05
U3120	----- -----			(1480R ONLY)		
U3120	156-0158-07	B082030		MICROCIRCUIT,LI:DUAL OPNL AMPL,SCREENED	01295	MC1458JG4
U3120	----- -----			(1480R ONLY)		
U3190	156-0402-00	B060000	B062556	MICROCIRCUIT,LI:TIMER	27014	LM555CN
U3190	----- -----			(1480C ONLY)		
U3190	156-0402-02	B062557		MICROCIRCUIT,LI:TIMER,CHK	27014	LM555CN/A+
U3190	----- -----			(1480C ONLY)		
U3190	156-0402-00	B060000	B067570	MICROCIRCUIT,LI:TIMER	27014	LM555CN
U3190	----- -----			(1480R ONLY)		
U3190	156-0402-02	B067571		MICROCIRCUIT,LI:TIMER,CHK	27014	LM555CN/A+
U3190	----- -----			(1480R ONLY)		
U3267	155-0144-00			MICROCIRCUIT,LI:DUAL IN-LINE,16 LEAD	80009	155-0144-00
U3268	156-0402-00	B060000	B062556	MICROCIRCUIT,LI:TIMER	27014	LM555CN
U3268	----- -----			(1480C ONLY)		
U3268	156-0402-02	B062557	B073677	MICROCIRCUIT,LI:TIMER,CHK	27014	LM555CN/A+
U3268	----- -----			(1480C ONLY)		
U3268	156-0402-00	B060000	B067570	MICROCIRCUIT,LI:TIMER	27014	LM555CN
U3268	----- -----			(1480R ONLY)		
U3268	156-0402-02	B067571	B082063	MICROCIRCUIT,LI:TIMER,CHK	27014	LM555CN/A+
U3268	----- -----			(1480R ONLY)		
U3268	156-0402-00	B060000	B062556	MICROCIRCUIT,LI:TIMER	27014	LM555CN
U3268	----- -----			(1481C ONLY)		
U3268	156-0402-02	B062557	B073678	MICROCIRCUIT,LI:TIMER,CHK	27014	LM555CN/A+
U3268	----- -----			(1481C ONLY)		
U3268	156-0402-00	B060000	B067570	MICROCIRCUIT,LI:TIMER	27014	LM555CN
U3268	----- -----			(1481R ONLY)		

	Tektronix	Serial/Model No.			Mfr	
Ckt No.	Part No.	Eff	Dscont	Name & Description	Code	Mfr Part Number
U3268	156-0402-02	B067571	B082044	MICROCIRCUIT,LI:TIMER,CHK	27014	LM555CN/A+
U3268	----- -----			(1481R ONLY)		
U3268	156-0402-00	B060000	B062556	MICROCIRCUIT,LI:TIMER	27014	LM555CN
U3268	----- -----			(1482C ONLY)		
U3268	156-0402-02	B062557	B073442	MICROCIRCUIT,LI:TIMER,CHK	27014	LM555CN/A+
U3268	----- -----			(1482C ONLY)		
U3268	156-0402-00	B060000	B067570	MICROCIRCUIT,LI:TIMER	27014	LM555CN
U3268	----- -----			(1482R ONLY)		
U3268	156-0402-02	B067571	B082230	MICROCIRCUIT,LI:TIMER,CHK	27014	LM555CN/A+
U3268	----- -----			(1482R ONLY)		
U3268	156-0402-00	B060000	B062556	MICROCIRCUIT,LI:TIMER	27014	LM555CN
U3268	----- -----			(1485C ONLY)		
U3268	156-0402-02	B062557	B073711	MICROCIRCUIT,LI:TIMER,CHK	27014	LM555CN/A+
U3268	----- -----			(1485C ONLY)		
U3268	156-0402-00	B060000	B067570	MICROCIRCUIT,LI:TIMER	27014	LM555CN
U3268	----- -----			(1485R ONLY)		
U3268	156-0402-02	B067571	B082046	MICROCIRCUIT,LI:TIMER,CHK	27014	LM555CN/A+
U3268	----- -----			(1485R ONLY)		
U3268	156-0402-02	B073678		MICROCIRCUIT,LI:TIMER,CHK	27014	LM555CN/A+
U3268	----- -----			(1480C OPTION 07 ONLY)		
U3268	156-0402-02	B082064		MICROCIRCUIT,LI:TIMER,CHK	27014	LM555CN/A+
U3268	----- -----			(1480R OPTION 07 ONLY)		
U3268	156-0402-02	B073679		MICROCIRCUIT,LI:TIMER,CHK	27014	LM555CN/A+
U3268	----- -----			(1481C OPTION 07 ONLY)		
U3268	156-0402-02	B082045		MICROCIRCUIT,LI:TIMER,CHK	27014	LM555CN/A+
U3268	----- -----			(1481R OPTION 07 ONLY)		
U3268	156-0402-02	B073443		MICROCIRCUIT,LI:TIMER,CHK	27014	LM555CN/A+
U3268	----- -----			(1482C OPTION 07 ONLY)		
U3268	156-0402-02	B082231		MICROCIRCUIT,LI:TIMER,CHK	27014	LM555CN/A+
U3268	----- -----			(1482R OPTION 07 ONLY)		
U3268	156-0402-02	B073712		MICROCIRCUIT,LI:TIMER,CHK	27014	LM555CN/A+
U3268	----- -----			(1485C OPTION 07 ONLY)		
U3268	156-0402-02	B082047		MICROCIRCUIT,LI:TIMER,CHK	27014	LM555CN/A+
U3268	----- -----			(1485R OPTION 07 ONLY)		
U3380	156-0158-00	B060000	B061408	MICROCIRCUIT,LI:DUAL OPERATIONAL AMPLIFIER	18324	MC1458N
U3380	----- -----			(1480C ONLY)		
U3380	156-0158-05	B061409	B073690	MICROCIRCUIT,LI:DUAL OPERATIONAL AMPLIFIER	80009	156-0158-05
U3380	----- -----			(1480C ONLY)		
U3380	156-0158-07	B073691		MICROCIRCUIT,LI:DUAL OPNL AMPL,SCREENED	01295	MC1458JG4
U3380	----- -----			(1480C ONLY)		
U3380	156-0158-00	B060000	B063359	MICROCIRCUIT,LI:DUAL OPERATIONAL AMPLIFIER	18324	MC1458N
U3380	----- -----			(1480R ONLY)		
U3380	156-0158-05	B063360	B082029	MICROCIRCUIT,LI:DUAL OPERATIONAL AMPLIFIER	80009	156-0158-05
U3380	----- -----			(1480R ONLY)		
U3380	156-0158-07	B082030		MICROCIRCUIT,LI:DUAL OPNL AMPL,SCREENED	01295	MC1458JG4
U3380	----- -----			(1480R ONLY)		
U4080	156-0405-03			MICROCIRCUIT,DI:DUAL RETRIG MONOSTABLE MV	07263	9602
U4260	156-0030-03			MICROCIRCUIT,DI:QUAD 2-INP NAND GATE,SCRN	01295	SN7400(NP3 OR JP
U4270	156-0030-03			MICROCIRCUIT,DI:QUAD 2-INP NAND GATE,SCRN	01295	SN7400(NP3 OR JP
U4280	156-0030-00			MICROCIRCUIT,DI:QUAD 2 INPUT NAND GATE	01295	SN7400(N OR J)
U4440	155-0028-00			MICROCIRCUIT,LI:ML,MILLER INTEGRATOR	80009	155-0028-00
U4460	156-0047-02			MICROCIRCUIT,DI:TP1 3 INP,NAND GATE	27014	DM7410NA+ OR JA+
U4460	----- -----			(1480C ONLY)		

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
U4460	156-0047-02			MICROCIRCUIT,DI:TP1 3 INP,NAND GATE	27014	DM7410NA+ OR JA+
U4460	----- -----			(1480R ONLY)		
U4550	156-0032-03			MICROCIRCUIT,DI:4 BIT BINARY COUNTER,SCRN	07263	7493(PCQR)
U4550	----- -----			(1480C ONLY)		
U4550	156-0032-03			MICROCIRCUIT,DI:4 BIT BINARY COUNTER,SCRN	07263	7493(PCQR)
U4550	----- -----			(1480R ONLY)		
U4560	156-0047-02			MICROCIRCUIT,DI:TP1 3 INP,NAND GATE	27014	DM7410NA+ OR JA+
U4560	----- -----			(1480C ONLY)		
U4560	156-0047-02			MICROCIRCUIT,DI:TP1 3 INP,NAND GATE	27014	DM7410NA+ OR JA+
U4560	----- -----			(1480R ONLY)		
U4570	156-0041-05			MICROCIRCUIT,DI:DUAL D-FLIP FLOP	01295	SN7474
U4580	156-0041-05			MICROCIRCUIT,DI:DUAL D-FLIP FLOP	01295	SN7474
U4640	156-0041-05			MICROCIRCUIT,DI:DUAL D-FLIP FLOP	01295	SN7474
U4660	156-0062-02			MICROCIRCUIT,DI:QUAD 2-INP EXCL OR GATE	01295	SN7486
U4670	156-0041-05			MICROCIRCUIT,DI:DUAL D-FLIP FLOP	01295	SN7474
U4680	156-0035-00			MICROCIRCUIT,DI:SGL 8-INPUT POS NAND GATE	80009	156-0035-00
U4740	156-0030-03			MICROCIRCUIT,DI:QUAD 2-INP NAND GATE,SCRN	01295	SN7400(NP3 OR JP
U4760	156-0057-02			MICROCIRCUIT,DI:QUAD 2-INP NAND GATE,SCRN	01295	SN7401(NP3 OR JP
U4770	156-0062-02			MICROCIRCUIT,DI:QUAD 2-INP EXCL OR GATE	01295	SN7486
U4780	156-0062-02			MICROCIRCUIT,DI:QUAD 2-INP EXCL OR GATE	01295	SN7486
U4810	155-0028-00			MICROCIRCUIT,LI:ML,MILLER INTEGRATOR	80009	155-0028-00
U4840	156-0030-03			MICROCIRCUIT,DI:QUAD 2-INP NAND GATE,SCRN	01295	SN7400(NP3 OR JP
U4850	156-0030-03			MICROCIRCUIT,DI:QUAD 2-INP NAND GATE,SCRN	01295	SN7400(NP3 OR JP
U4860	156-0041-05			MICROCIRCUIT,DI:DUAL D-FLIP FLOP	01295	SN7474
U4880	156-0047-02			MICROCIRCUIT,DI:TP1 3 INP,NAND GATE	27014	DM7410NA+ OR JA+
U4880	----- -----			(1480C ONLY)		
U4880	156-0047-02			MICROCIRCUIT,DI:TP1 3 INP,NAND GATE	27014	DM7410NA+ OR JA+
U4880	----- -----			(1480R ONLY)		
U4930	156-0057-02			MICROCIRCUIT,DI:QUAD 2-INP NAND GATE,SCRN	01295	SN7401(NP3 OR JP
U6060	156-0071-00	B060000	B062556	MICROCIRCUIT,LI:VOLTAGE REGULATOR	04713	MC1723CL
U6060	----- -----			(1480C ONLY)		
U6060	156-0071-02	B062557		MICROCIRCUIT,LI:VOLTAGE REGULATOR	04713	MC1723CLDS
U6060	----- -----			(1480C ONLY)		
U6060	156-0071-00	B060000	B067570	MICROCIRCUIT,LI:VOLTAGE REGULATOR	04713	MC1723CL
U6060	----- -----			(1480R ONLY)		
U6060	156-0071-02	B067571		MICROCIRCUIT,LI:VOLTAGE REGULATOR	04713	MC1723CLDS
U6060	----- -----			(1480R ONLY)		
U6160	156-0071-00	B060000	B062556	MICROCIRCUIT,LI:VOLTAGE REGULATOR	04713	MC1723CL
U6160	----- -----			(1480C ONLY)		
U6160	156-0071-02	B062557		MICROCIRCUIT,LI:VOLTAGE REGULATOR	04713	MC1723CLDS
U6160	----- -----			(1480C ONLY)		
U6160	156-0071-00	B060000	B067570	MICROCIRCUIT,LI:VOLTAGE REGULATOR	04713	MC1723CL
U6160	----- -----			(1480R ONLY)		
U6160	156-0071-02	B067571		MICROCIRCUIT,LI:VOLTAGE REGULATOR	04713	MC1723CLDS
U6160	----- -----			(1480R ONLY)		
U6474	156-0048-00	B060000	B062556	MICROCIRCUIT,LI:FIVE NPN TRANSISTOR ARRAY	02735	CA3046
U6474	----- -----			(1480C ONLY)		
U6474	156-0048-02	B062557		MICROCIRCUIT,LI:5 XSTR ARRAY	02735	CA3046EX98
U6474	----- -----			(1480C ONLY)		
U6474	156-0048-00	B060000	B067570	MICROCIRCUIT,LI:FIVE NPN TRANSISTOR ARRAY	02735	CA3046
U6474	----- -----			(1480R ONLY)		
U6474	156-0048-02	B067571		MICROCIRCUIT,LI:5 XSTR ARRAY	02735	CA3046EX98
U6474	----- -----			(1480R ONLY)		

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
U6535	156-0067-00	B060000	B061850	MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	04713	MC1741CP1
U6535	----- -----			(1480C ONLY)		
U6535	156-0067-11	B061851	B073693	MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	02735	CA741CE
U6535	----- -----			(1480C ONLY)		
U6535	156-0067-13	B073694		MICROCIRCUIT,LI:OPNL AMPL,SELECTED	01295	UA741CJG4
U6535	----- -----			(1480C ONLY)		
U6535	156-0067-00	B060000	B064673	MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	04713	MC1741CP1
U6535	----- -----			(1480R ONLY)		
U6535	156-0067-11	B064674	B081953	MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	02735	CA741CE
U6535	----- -----			(1480R ONLY)		
U6535	156-0067-13	B081954		MICROCIRCUIT,LI:OPNL AMPL,SELECTED	01295	UA741CJG4
U6535	----- -----			(1480R ONLY)		
U7160	156-0030-03			MICROCIRCUIT,DI:QUAD 2-INP NAND GATE,SCRN	01295	SN7400(NP3 OR JP
U7160	----- -----			(OPTION 04 ONLY)		
U7200	156-0041-05			MICROCIRCUIT,DI:DUAL D-FLIP FLOP	01295	SN7474
U7200	----- -----			(OPTION 04 ONLY)		
U8007	156-0062-02			MICROCIRCUIT,DI:QUAD 2-INP EXCL OR GATE	01295	SN7486
U8035	156-0062-02			MICROCIRCUIT,DI:QUAD 2-INP EXCL OR GATE	01295	SN7486
U9240	152-0587-00			SEMICOND DEVICE:V MULTR,8KV IN,16KV DC OUT	52306	CMX192
U9443	156-0158-00	B060000	B073690	MICROCIRCUIT,LI:DUAL OPERATIONAL AMPLIFIER	18324	MC1458N
U9443	----- -----			(1480C OPTION 07 ONLY)		
U9443	156-0158-07	B073691		MICROCIRCUIT,LI:DUAL OPNL AMPL,SCREENED	01295	MC1458JG4
U9443	----- -----			(1480C OPTION 07 ONLY)		
U9443	156-0158-00	B060000	B082029	MICROCIRCUIT,LI:DUAL OPERATIONAL AMPLIFIER	18324	MC1458N
U9443	----- -----			(1480R OPTION 07 ONLY)		
U9443	156-0158-07	B082030		MICROCIRCUIT,LI:DUAL OPNL AMPL,SCREENED	01295	MC1458JG4
U9443	----- -----			(1480R OPTION 07 ONLY)		
U9700	156-0277-00			MICROCIRCUIT,LI:VOLTAGE REGULATOR	07263	MICROA7805UC
V9600	154-0718-10	B060000	B073470	ELECTRON TUBE:CRT,P31	80009	154-0718-10
V9600	----- -----			(1480C ONLY)		
V9600	154-0852-00	B073471	B073801	ELECTRON TUBE:CRT,T1480-31-3.04	80009	154-0852-00
V9600	----- -----			(1480C ONLY)		
V9600	154-0877-00	B073802		ELECTRON TUBE:FINISHED T1480-31-3.04	80009	154-0877-00
V9600	----- -----			(1480C ONLY)		
V9600	154-0718-10	B060000	B079948	ELECTRON TUBE:CRT,P31	80009	154-0718-10
V9600	----- -----			(1480R ONLY)		
V9600	154-0852-00	B079949	B082980	ELECTRON TUBE:CRT,T1480-31-3.04	80009	154-0852-00
V9600	----- -----			(1480R ONLY)		
V9600	154-0877-00	B082981		ELECTRON TUBE:FINISHED T1480-31-3.04	80009	154-0877-00
V9600	----- -----			(1480R ONLY)		
V9600	154-0718-01	B060000	B073204	ELECTRON TUBE:CRT,P31,INT SCALE	80009	154-0718-01
V9600	----- -----			(1481C,1482C,1485C ONLY)		
V9600	154-0851-00	B073205	B083864	ELECTRON TUBE:CRT,T1480-31-3.03	80009	154-0851-00
V9600	----- -----			(1481C,1482C,1485C ONLY)		
V9600	154-0876-00	B083865		ELECTRON TUBE:FINISHED T1480-31-3.03	80009	154-0876-00
V9600	----- -----			(1481C,1482C,1485C ONLY)		
V9600	154-0718-01	B060000	B080999	ELECTRON TUBE:CRT,P31,INT SCALE	80009	154-0718-01
V9600	----- -----			(1481R,1482R,1485R ONLY)		
V9600	154-0851-00	B081000	B093321	ELECTRON TUBE:CRT,T1480-31-3.03	80009	154-0851-00
V9600	----- -----			(1481R,1482R,1485R ONLY)		
V9600	154-0876-00	B093322		ELECTRON TUBE:FINISHED T1480-31-3.03	80009	154-0876-00
V9600	----- -----			(1481R,1482R,1485R ONLY)		
V9600	154-0718-00	B060000	B073470	ELECTRON TUBE:CRT,P31,INT SCALE	80009	154-0718-00
V9600	----- -----			(1480C OPTION 03 ONLY)		

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
V9600	154-0853-00	B073471	B083981	ELECTRON TUBE:T1480	80009	154-0853-00
V9600	----- -----			(1480C OPTION 03 ONLY)		
V9600	154-0878-00	B083982		ELECTRON TUBE:FINISHED T1480-31-5.03	80009	154-0878-00
V9600	----- -----			(1480C OPTION 03 ONLY)		
V9600	154-0718-05	B060000	B080999	ELECTRON TUBE:CRT,P31,INT SCALE	80009	154-0718-05
V9600	----- -----			(1480R OPTION 03 ONLY)		
V9600	154-0853-00	B081000	B093535	ELECTRON TUBE:T1480	80009	154-0853-00
V9600	----- -----			(1480R OPTION 03 ONLY)		
V9600	154-0878-00	B093536		ELECTRON TUBE:FINISHED T1480-31-5.03	80009	154-0878-00
V9600	----- -----			(1480R OPTION 03 ONLY)		
VR1520	152-0461-00			SEMICOND DEVICE:ZENER,0.4W,6.2V,5%	04713	SZG25002K2
VR1579	152-0306-00			SEMICOND DEVICE:ZENER,0.4W,9.1V,5%	15238	Z5409
VR2242	152-0280-00			SEMICOND DEVICE:ZENER,0.4W,6.2V,5%	80009	152-0280-00
VR2242	----- -----			(OPTION 01 ONLY)		
VR3269	152-0195-00			SEMICOND DEVICE:ZENER,0.4W,5.1V,5%	04713	SZ11755
VR3277	152-0175-00			SEMICOND DEVICE:ZENER,0.4W,5.6V,5%	04713	SZG35008
VR3450	152-0195-00			SEMICOND DEVICE:ZENER,0.4W,5.1V,5%	04713	SZ11755
VR6071	152-0317-00			SEMICOND DEVICE:ZENER,0.25W,6.2V,5%	04713	SZG20012
VR6528	152-0227-00			SEMICOND DEVICE:ZENER,0.4W,6.2V,5%	04713	SZ13903
VR6646	152-0247-00			SEMICOND DEVICE:ZENER,0.4W,150V,5%	04713	SZG275K1RL
VR6946	150-0050-00			LAMP,GLOW:135V MAX,1.9MA	74276	LT2-24-2(NE2H)
VR6960	150-0050-00			LAMP,GLOW:135V MAX,1.9MA	74276	LT2-24-2(NE2H)
VR6962	150-0050-00			LAMP,GLOW:135V MAX,1.9MA	74276	LT2-24-2(NE2H)
WR1523	131-0566-00			BUS CONDUCTOR:DUMMY RES,2.375,22 AWG	57668	JWW-0200E0
WR1820	131-0566-00			BUS CONDUCTOR:DUMMY RES,2.375,22 AWG	57668	JWW-0200E0
Z9015	388-4026-00			CIRCUIT BOARD:LOOP THRU COMP	80009	388-4026-00
Z9025	388-4026-00			CIRCUIT BOARD:LOOP THRU COMP	80009	388-4026-00
Z9115	388-4026-00			CIRCUIT BOARD:LOOP THRU COMP	80009	388-4026-00
Z9125	388-4026-00			CIRCUIT BOARD:LOOP THRU COMP	80009	388-4026-00

OPTIONS

Most of the customer available options to the 1480-Waveform Monitors are integrated into the main body of text and the diagrams. In the case of Option 6, however, its complexity forced a separate supplementary Instructions Manual.

Available Options

Option 01. AX10 PROBE INPUT to the vertical channel of the 1480-Waveform Monitor.

Option 02. A carrying case for the cabinet models. A painted metal carrying case is available for portable use. Tektronix Part Number 016-0084-00 is a painted aluminum case with hard-rubber feet and handle.

Option 03. A blank crt. Blank crts are normally used with locally produced special purpose graticules when the 1480-Series internal graticules are not desired.

Option 04. Video Tape Recorder (VTR) TONE-WHEEL SYNC INPUT. Available in single-standard and dual (NTSC-PAL)-standard cabinet models (1480C, 1481C, 1482C, and 1485C), designed to trigger on the tone wheel sync output of VTRs. CRT and line voltage selections are dependant on the instrument model ordered.

Option 05. Identical to Option 04 except that it's available on the NTSC-PAL dual standard model (1485C) only, has an NTSC internal graticule scale, and is wired for 120 V primary mains.

Option 06. 124 Ω Balanced Line inputs. Information contained in special supplemental manual Tektronix Part Number 070-2064-00.

Option 07. Slow Sweep. Provides a slow time base for "bounce testing" distribution circuits. European versions of this option also contain 50–60 Hz squarewave triggering capabilities (AUX SYNC IN).

Option 08. (1481 and 1485 only). SECAM Field Identification. Information contained in special supplemental manual, Tektronix Part Number 061-1716-00.

DIAGRAMS & CIRCUIT BOARD ILLUSTRATIONS

This section of the manual contains block and schematic diagrams with waveforms, and etched circuit board illustrations.

Symbols

Symbols used on the diagrams are based on ANSI Y32.2-1975 and IEEE No. 315 March 1971. Logic symbology is based on ANSI Y32.14-1973 (IEEE Std. 91-1973). Logic symbols depict the logic function performed and may differ from the manufacturer's data.

Component values

Electrical components shown on the diagrams are in the following units unless noted otherwise:

Capacitors = Values one or greater are in picofarads (pF).
Values less than one are in microfarads (μF).

Resistors = Ohms (Ω).

Semiconductor Types

Refer to the Replaceable Electrical Parts list.

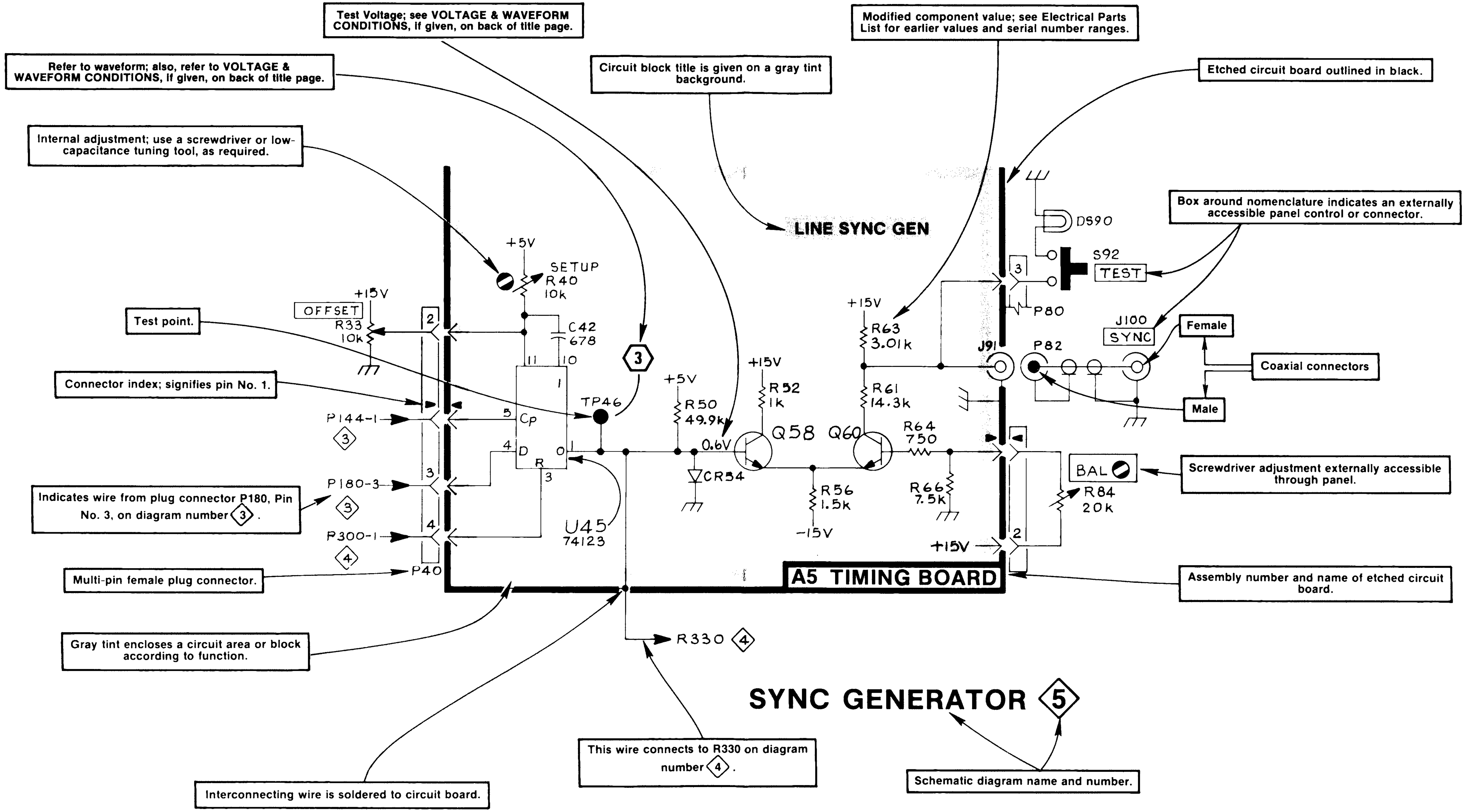
Reference Designators

The following letters are used as reference designators to identify components or assemblies on Tektronix, Inc. schematic diagrams.

A	Assembly, separable or repairable (circuit board, etc.)
AT	Attenuator, fixed or variable
B	Motor
BT	Battery
C	Capacitor, fixed or variable
CR	Diode, signal or rectifier
DH	Decoupling Hybrid
DL	Delay Line
DS	Indicating device (lamp)
E	Spark Gap
F	Fuse
FL	Filter
H	Heat dissipating device (heat sink, heat radiator, etc.)
HR	Heater
J	Connector, stationary portion
K	Relay
L	Inductor, fixed or variable
LR	Inductor/resistor combination
M	Meter
P	Connector, movable portion
Q	Transistor, silicon-controlled rectifier, or programmable unijunction transistor
R	Resistor, fixed or variable
RT	Thermistors
S	Switch
T	Transformer
TC	Thermocouple
TP	Test Point
U	Assembly, inseparable or non-repairable (integrated circuit, etc.)
V	Electron tube
VR	Voltage regulator (zener diode, etc.)
Y	Crystal

Partial Schematic Diagram With Explanations

The partial diagram at the left is an example of the various symbols and other information provided on Tektronix, Inc. diagrams.


Test Voltage; see VOLTAGE & WAVEFORM CONDITIONS, if given, on back of title page.
Modified component value; see Electrical Parts List for earlier values and serial number ranges.
Refer to waveform; also, refer to VOLTAGE & WAVEFORM CONDITIONS, if given, on back of title page.
Circuit block title is given on a gray tint background.
Etched circuit board outlined in black.
Internal adjustment; use a screwdriver or low-capacitance tuning tool, as required.
LINE SYNC GEN
Box around nomenclature indicates an externally accessible panel control or connector.
+5V
SETUP
R40
10k
DS90
S92
TEST
P80
+15V
OFFSET
R33
10k
Test point.
C42
678
3
+15V
R63
3.01k
J100
SYNC
Female
J91
P82
Coaxial connectors
Connector index; signifies pin No. 1.
TP46
+5V
R50
49.9k
R52
1k
R61
14.3k
Male
P144-1
Cp
Q58
Q60
R64
750
0.6V
D
R
U45
74123
CR54
R56
1.5k
-15V
R66
7.5k
BAL
R84
20k
Screwdriver adjustment externally accessible through panel.
P180-3
Indicates wire from plug connector P180, Pin No. 3, on diagram number 3.
P300-1
+15V
Multi-pin female plug connector.
P40
A5 TIMING BOARD
Assembly number and name of etched circuit board.
Gray tint encloses a circuit area or block according to function.
R330 4
SYNC GENERATOR 5
This wire connects to R330 on diagram number 4.
Schematic diagram name and number.
Interconnecting wire is soldered to circuit board.

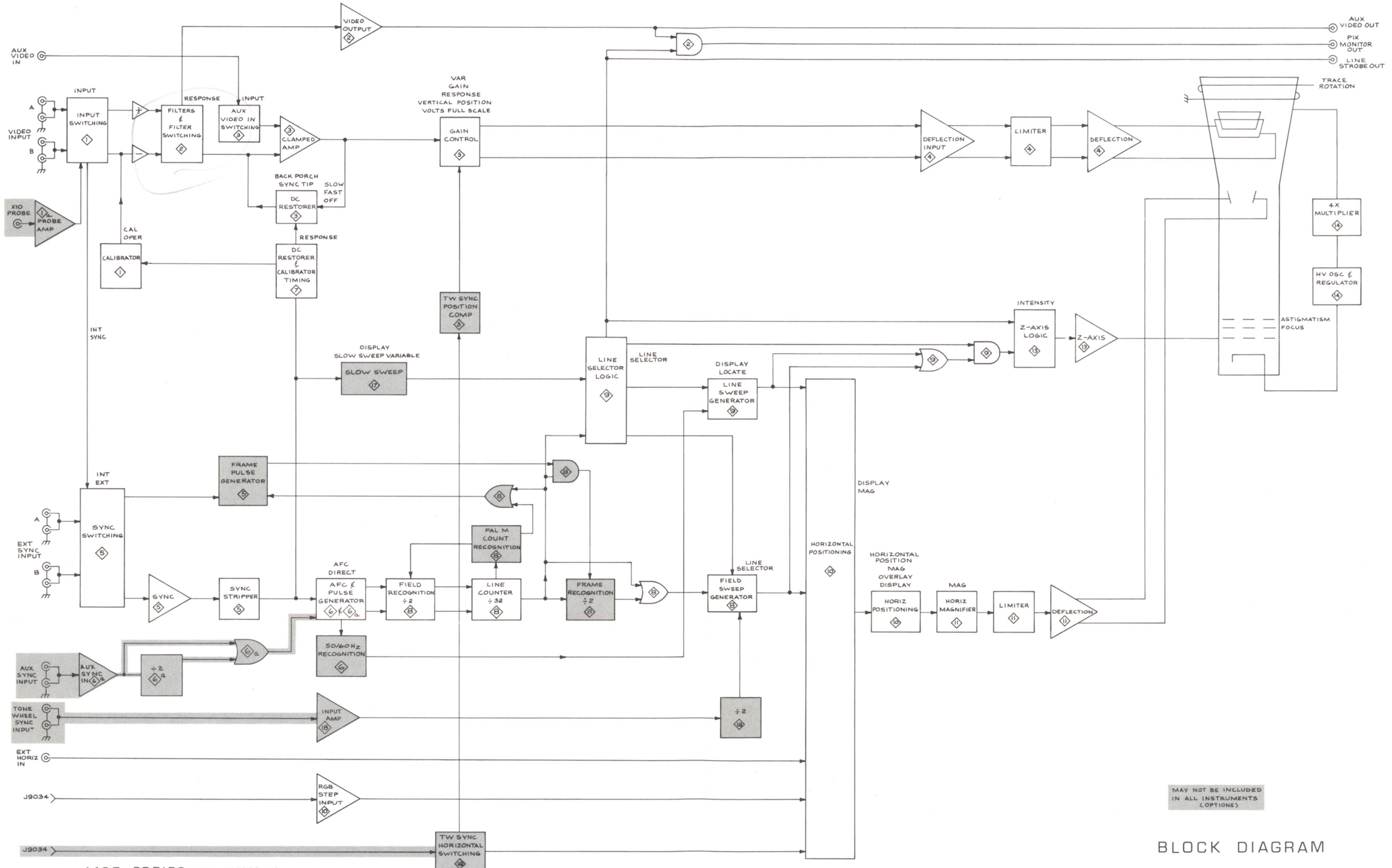
SCHEMATIC EXAMPLE

(2234)2238-50

WAVEFORM CONDITIONS

Waveform photographs in this section were taken with a Tektronix C-59 Oscilloscope Camera mounted on a Tektronix 7603 Oscilloscope with 7B53A Time Base and 7A18 Dual Trace Amplifier plug-ins.

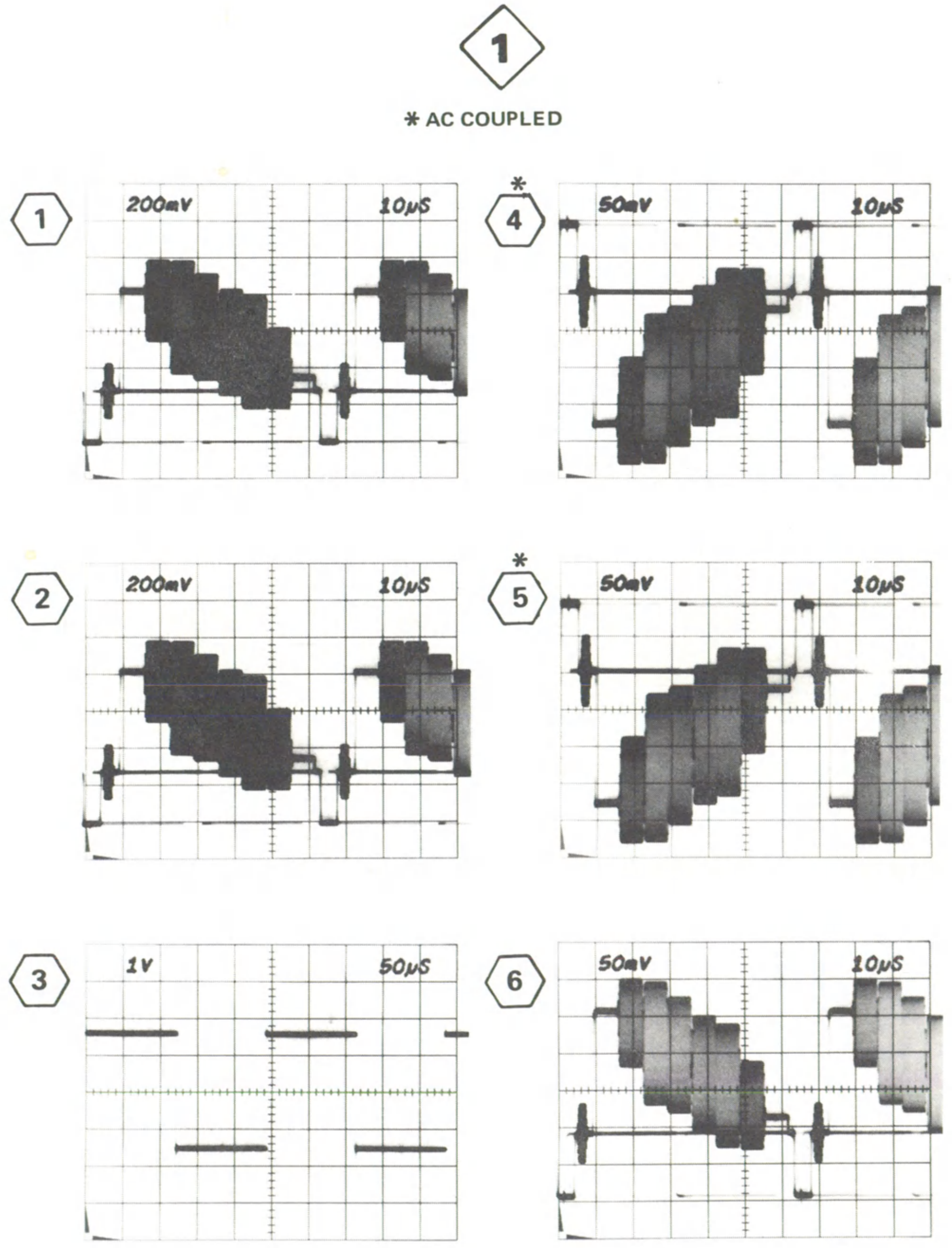
The vertical input was dc coupled except for those waveforms identified as ac coupled.


AUX VIDEO IN
VIDEO INPUT
A
B
INPUT
INPUT SWITCHING 1
+
−
RESPONSE
FILTERS & FILTER SWITCHING 2
INPUT
AUX VIDEO IN SWITCHING 3
3 CLAMPED AMP
VIDEO OUTPUT 2
X10 PROBE
1a PROBE AMP
BACK PORCH
SYNC TIP
SLOW
FAST
OFF
DC RESTORER 3
RESPONSE
CAL
OPER
CALIBRATOR 1
DC RESTORER & CALIBRATOR TIMING 7
VAR
GAIN
RESPONSE
VERTICAL POSITION
VOLTS FULL SCALE
GAIN CONTROL 3
TW SYNC POSITION COMP 3
INT SYNC
DISPLAY
SLOW SWEEP VARIABLE
SLOW SWEEP 17
2
AUX VIDEO OUT
PIX MONITOR OUT
LINE STROBE OUT
TRACE ROTATION
DEFLECTION INPUT 4
LIMITER 4
DEFLECTION 4
4X MULTIPLIER 14
HV OSC & REGULATOR 14
ASTIGMATISM
FOCUS
INTENSITY
Z-AXIS LOGIC 13
Z-AXIS 13
LINE SELECTOR LOGIC 9
LINE SELECTOR
9
9
DISPLAY
LOCATE
LINE SWEEP GENERATOR 9
DISPLAY
MAG
INT
EXT
EXT SYNC INPUT
A
B
SYNC SWITCHING 5
FRAME PULSE GENERATOR 5
8
8
PAL M COUNT RECOGNITION 8
SYNC 5
SYNC STRIPPER 5
AFC
DIRECT
AFC & PULSE GENERATOR 6 & 6a
FIELD RECOGNITION ÷2 8
LINE COUNTER ÷32 8
FRAME RECOGNITION ÷2 8
8
LINE SELECTOR
FIELD SWEEP GENERATOR 8
HORIZONTAL POSITIONING 10
HORIZONTAL
POSITION
MAG
OVERLAY
DISPLAY
HORIZ POSITIONING 10
MAG
HORIZ MAGNIFIER 11
LIMITER 11
DEFLECTION 11
AUX SYNC INPUT
AUX SYNC IN 6a
÷2 6a
6a
50/60 Hz RECOGNITION 6
TONE WHEEL SYNC INPUT
INPUT AMP 18
÷2 18
EXT HORIZ IN
J9034
RGB STEP INPUT 10
J9034
TW SYNC HORIZONTAL SWITCHING 18
MAY NOT BE INCLUDED IN ALL INSTRUMENTS (OPTIONS)

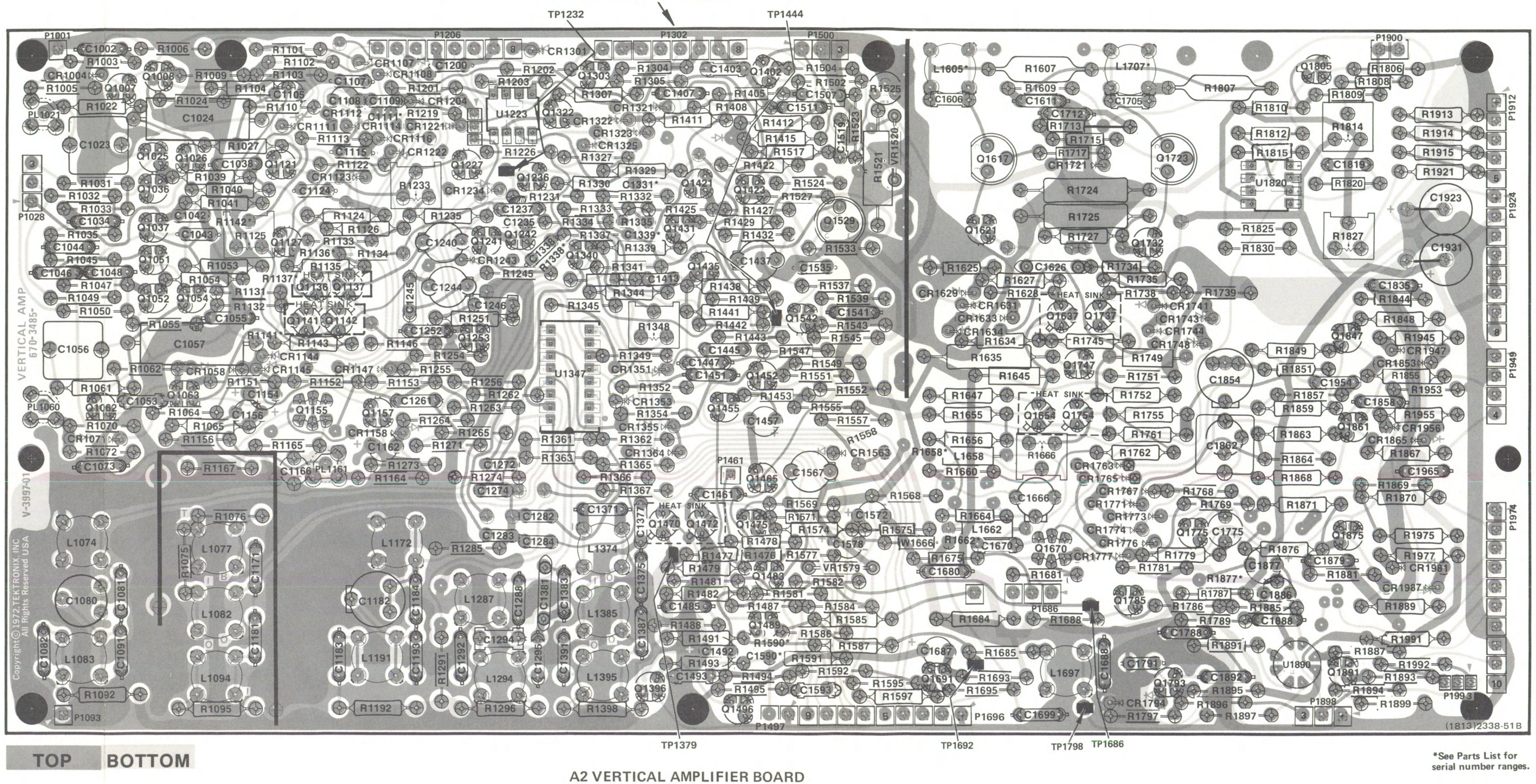
1480 SERIES (SN B060000-up)

REV B SEP 1980

BLOCK DIAGRAM



NOTE: Run from R1537 to P1302, Pin 5.
Replaced by wire strap on rear of board.


TP1232
TP1444
P1001
P1206
P1302
P1500
P1900
P1912
P1924
P1949
P1974
P1028
P1060
P1093
P1497
P1686
P1696
P1898
P1993
P1461
VERTICAL AMP
670-3485-
V-3997-01
Copyright © 1972 TEKTRONIX INC
All Rights Reserved USA
HEAT SINK
U1223
U1347
U1820
U1890
TP1379
TP1692
TP1798
TP1686
(1813)2338-51B
TOP
BOTTOM

*See Parts List for serial number ranges.

A2 VERTICAL AMPLIFIER BOARD

REV OCT 1983

①

PARTS LOCATING CHART

A INPUT

C1046
C1048
C1053
C1056
C1057
C1073

CR1071

Q1051
Q1052
Q1054
Q1062

R1045
R1047
R1049
R1050
R1054

R1055
R1061
R1062
R1064
R1070
R1072

10 V SUPPLY

C1042
C1043

Q1037

R1040
R1041
R1053

*See Parts List for serial number ranges.

B INPUT

C1002
C1023
C1024

C1034
C1044
C1108

CR1004
CR1107
CR1108
CR1112

Q1007
Q1025
Q1026
Q1036

R1003
R1005
R1006
R1022
R1024
R1031

R1032
R1033
R1035
R1039
R1101

CALIBRATOR INPUT

C1338
C1507

CR1301
CR1321

Q1303
Q1322

R1202
R1203
R1304
R1305

R1307
R1337
R1405
R1408
R1411

U1223

INPUT SWITCHING

C1105
C1107
C1109
C1111*
C1115
C1154
C1200
C1252

CR1058
CR1111
CR1114
CR1116
CR1123
CR1144

CR1145
CR1147
CR1204
CR1221

CR1222
CR1243
CR1322
CR1323
CR1325

Q1008
Q1063
Q1121
Q1127
Q1227
Q1253

R1009
R1027
R1102
R1103
R1110
R1113

R1122
R1135
R1151
R1152
R1153
R1201

R1219
R1226
R1254
R1255
R1327
R1329

+ AMPLIFIER

C1055
C1244
C1245
C1246
C1541

Q1141
Q1142
Q1241
Q1542

R1131
R1132
R1141*
R1142*
R1143
R1146
R1245

R1251
R1341
R1537
R1539
R1543
R1545

TP1444

− AMPLIFIER

C1038
C1124
C1235
C1237
C1240
C1445

Q1136
Q1137
Q1242

R1104
R1124
R1125
R1126
R1134

R1133
R1136*
R1137*
R1231
R1233
R1235
R1334
R1443

TP1232

X10 PROBE SWITCHING

(PART OF OPTION 1)

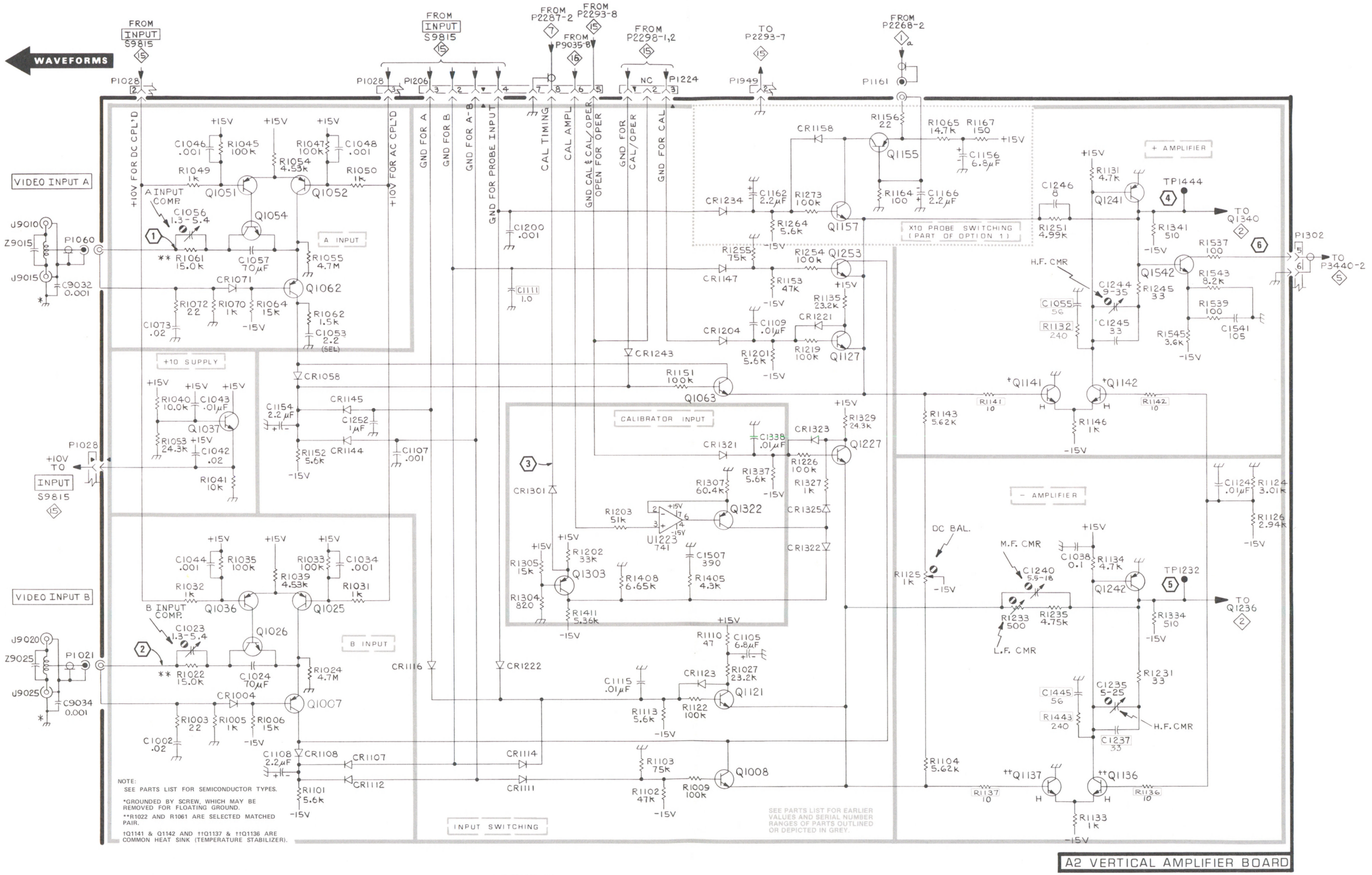
C1156
C1162
C1166

CR1158
CR1234

Q1155
Q1157

R1065
R1156
R1160
R1164

R1165
R1167
R1264
R1273


WAVEFORMS
FROM INPUT S9815 ⑮
P1028
FROM INPUT S9815 ⑮
P1028 P1206
FROM P2287-2 ⑦
FROM P2293-8 ⑮
FROM P9035-8 ⑯
FROM P2298-1,2 ⑮
NC
P1224
TO P2293-7 ⑮
P1949
FROM P2268-2 ①
P1161
VIDEO INPUT A
VIDEO INPUT B
J9010
Z9015
J9015
P1060
C9032 0.001
J9020
Z9025
J9025
P1021
C9034 0.001
+10V FOR DC CPL'D
+10V FOR AC CPL'D
GND FOR A
GND FOR B
GND FOR A-B
GND FOR PROBE INPUT
CAL TIMING
CAL AMPL
GND CAL & CAL/OPER OPEN FOR OPER
GND FOR CAL/OPER
GND FOR CAL
A INPUT COMP.
C1056 1.3-5.4
** R1061 15.0K
C1046 .001
R1045 100K
R1049 1K
Q1051
Q1054
R1054 4.53K
R1047 100K
C1048 .001
R1050 1K
Q1052
C1057 70µF
CR1071
R1055 4.7M
Q1062
R1072 22
R1070 1K
R1064 15K
R1062 1.5K
C1053 2.2 (SEL)
C1073 .02
A INPUT
+10 SUPPLY
R1040 10.0K
C1043 .01µF
Q1037
R1053 24.3K
C1042 .02
R1041 10K
P1028
+10V TO INPUT S9815 ⑮
B INPUT COMP.
C1023 1.3-5.4
** R1022 15.0K
C1044 .001
R1035 100K
R1032 1K
Q1036
R1033 100K
R1039 4.53K
C1034 .001
R1031 1K
Q1025
Q1026
C1024 70µF
R1024 4.7M
CR1004
Q1007
R1003 22
R1005 1K
R1006 15K
C1002 .02
B INPUT
CR1058
C1154 2.2µF
CR1145
C1252 1µF
CR1144
R1152 5.6K
C1107 .001
C1108 2.2µF
CR1108
CR1107
CR1112
R1101 5.6K
C1200 .001
C1111 1.0
CR1116
CR1222
CR1114
CR1111
CR1243
R1151 100K
Q1063
CALIBRATOR INPUT
CR1301
CR1321
C1338 .01µF
R1337 5.6K
R1307 60.4K
R1203 51K
U1223 741
Q1322
R1305 15K
R1202 33K
Q1303
R1304 820
R1408 6.65K
C1507 390
R1405 4.3K
R1411 5.36K
CR1323
R1329 24.3K
Q1227
R1226 100K
R1327 1K
CR1325
CR1322
R1110 47
C1105 6.8µF
CR1123
R1027 23.2K
Q1121
C1115 .01µF
R1113 5.6K
R1122 100K
R1103 75K
R1102 47K
R1009 100K
Q1008
INPUT SWITCHING
CR1158
R1156 22
Q1155
R1065 14.7K
R1167 150
C1156 6.8µF
R1164 100
C1166 2.2µF
CR1234
C1162 2.2µF
R1273 100K
R1264 5.6K
Q1157
X10 PROBE SWITCHING (PART OF OPTION 1)
R1255 75K
R1254 100K
Q1253
CR1147
R1153 47K
R1135 23.2K
C1109 .01µF
CR1221
CR1204
R1201 5.6K
R1219 100K
Q1127
+ AMPLIFIER
R1131 4.7K
C1246 8
Q1241
TP1444 ④
R1251 4.99K
R1341 510
TO Q1340 ②
R1537 100
⑥
P1302
TO P3440-2 ⑤
Q1542
R1543 8.2K
H.F. CMR
C1244 9-35
C1055 56
R1132 240
C1245 33
R1245 33
R1539 100
C1541 105
R1545 3.6K
†Q1141
R1141 10
†Q1142
R1142 10
R1143 5.62K
R1146 1K
− AMPLIFIER
C1124 .01µF
R1124 3.01K
R1126 2.94K
DC BAL.
R1125 1K
M.F. CMR
C1240 5.5-18
C1038 0.1
R1134 4.7K
Q1242
TP1232 ⑤
TO Q1236 ②
R1233 500
R1235 4.75K
L.F. CMR
R1334 510
R1231 33
C1445 56
C1235 5-25
R1443 240
H.F. CMR
C1237 33
R1104 5.62K
††Q1137
R1137 10
††Q1136
R1136 10
R1133 1K
H
+15V
−15V
①
②
③
A2 VERTICAL AMPLIFIER BOARD

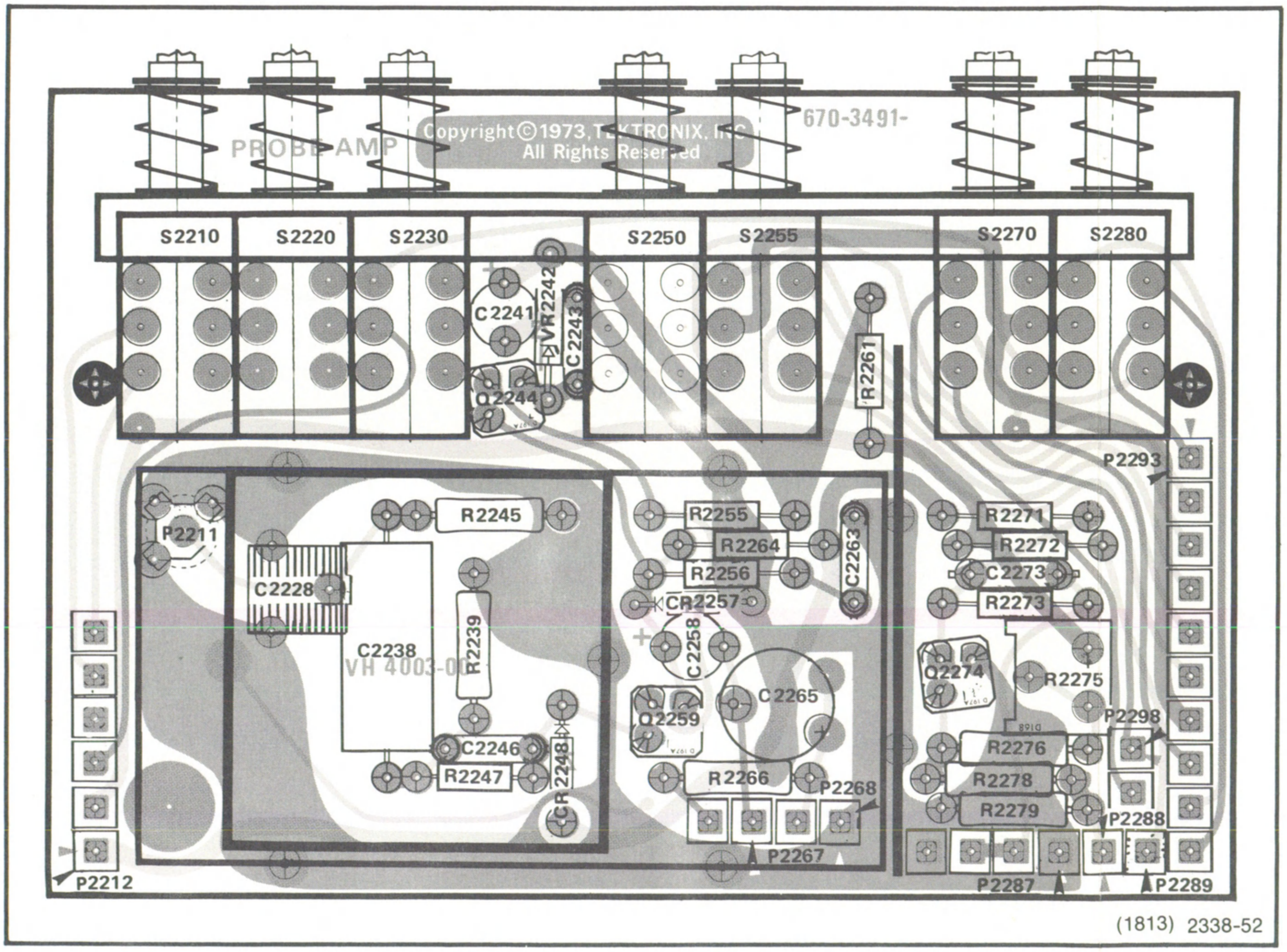
NOTE:
SEE PARTS LIST FOR SEMICONDUCTOR TYPES.
*GROUNDED BY SCREW, WHICH MAY BE REMOVED FOR FLOATING GROUND.
**R1022 AND R1061 ARE SELECTED MATCHED PAIR.
†Q1141 & Q1142 AND ††Q1137 & ††Q1136 ARE COMMON HEAT SINK (TEMPERATURE STABILIZER).

SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS OUTLINED OR DEPICTED IN GREY.

1480 SERIES (SN B060000-up)

(1813)2338-67
REV MAY 1985

VERTICAL INPUT & SWITCHING LOGIC ①


PROBE AMP
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670-3491-
S2210
S2220
S2230
S2250
S2255
S2270
S2280
C2241
VR2242
C2243
Q2244
R2261
P2293
P2211
R2245
C2228
C2238
VH 4003-00
R2239
C2246
R2247
CR2248
R2255
R2264
R2256
C2263
CR2257
C2258
Q2259
C2265
R2266
P2268
P2267
R2271
R2272
C2273
R2273
Q2274
R2275
P2298
R2276
R2278
R2279
P2288
P2287
P2289
P2212
(1813) 2338-52

A1-1 VERTICAL SWITCHING & X10 PROBE BOARD

TOP	BOTTOM

1a

PARTS LOCATING CHART

AMPLIFIER

C2228
C2238
C2241
C2243
C2246

C2258
C2263
C2265

CR2248
CR2257

Q2244
Q2259

R2239
R2245
R2247
R2255
R2256
R2261
R2264
R2266

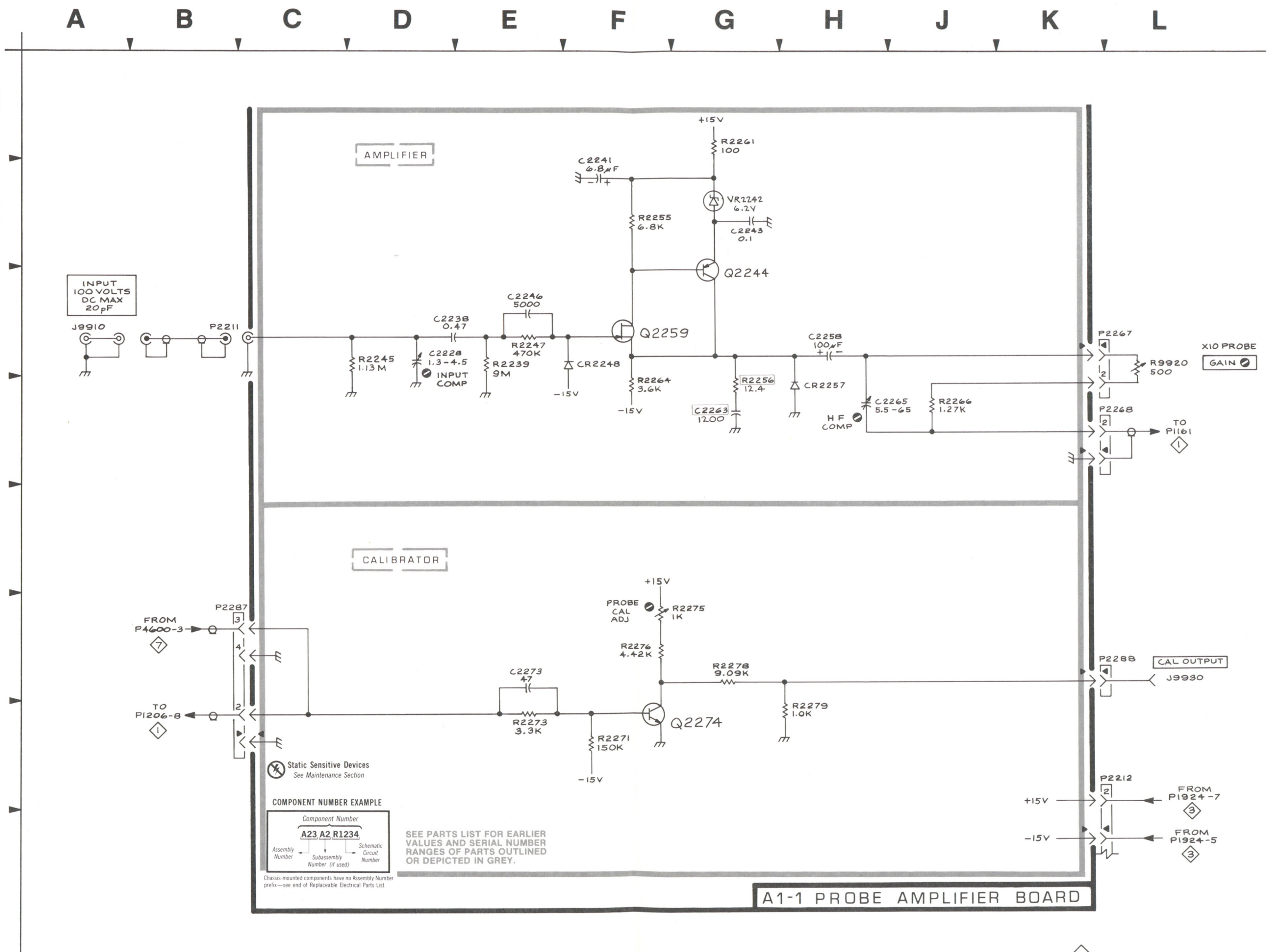
VR2242

CALIBRATOR

C2273

Q2274

R2271
R2273
R2275
R2276
R2278
R2279


A
B
C
D
E
F
G
H
J
K
L
1
2
3
4
5
6
7
8
AMPLIFIER
INPUT 100 VOLTS DC MAX 20pF
J9910
P2211
R2245 1.13M
C2228 1.3-4.5
INPUT COMP
C2238 0.47
R2239 9M
C2246 5000
R2247 470K
CR2248
-15V
Q2259
C2241 6.8μF
+15V
R2261 100
VR2242 6.2V
C2243 0.1
R2255 6.8K
Q2244
R2264 3.6K
-15V
R2256 12.4
C2263 1200
CR2257
C2258 100μF
C2265 5.5-65
HF COMP
R2266 1.27K
P2267
2
R9920 500
X10 PROBE
GAIN
P2268
2
TO P1161
1
CALIBRATOR
P2287
3
4
2
FROM P4600-3
7
TO P1206-8
1
+15V
PROBE CAL ADJ
R2275 1K
R2276 4.42K
C2273 47
R2273 3.3K
R2271 150K
-15V
Q2274
R2278 9.09K
R2279 1.0K
P2288
CAL OUTPUT
J9930
P2212
2
+15V
-15V
FROM P1924-7
3
FROM P1924-5
3
Static Sensitive Devices
See Maintenance Section
COMPONENT NUMBER EXAMPLE
Component Number
A23 A2 R1234
Assembly Number
Subassembly Number (if used)
Schematic Circuit Number
Chassis-mounted components have no Assembly Number prefix—see end of Replaceable Electrical Parts List.
SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS OUTLINED OR DEPICTED IN GREY.
A1-1 PROBE AMPLIFIER BOARD

1480 SERIES (SN B060000-up)

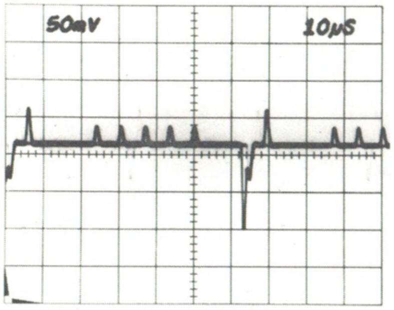
REV MAY 1984

X10 PROBE 1a
(OPTION 1)

2

*AC COUPLED

1



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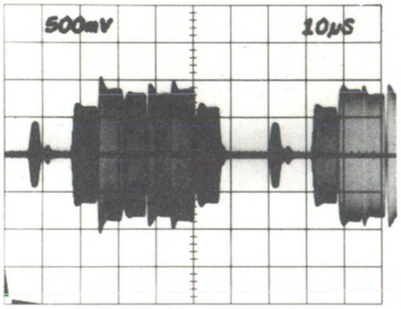

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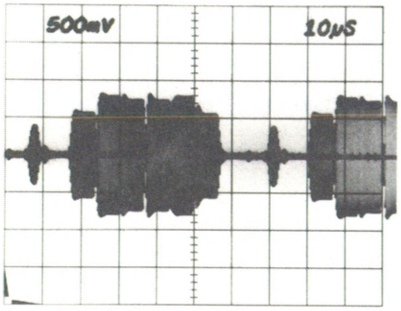

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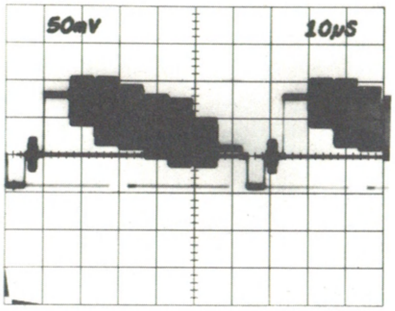
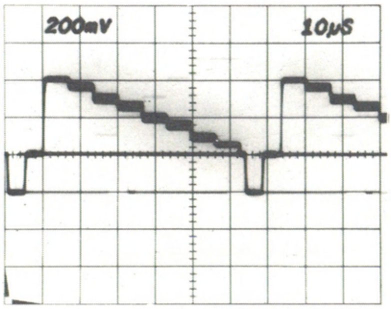


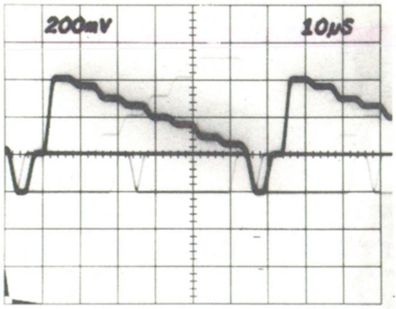
Blanking –460mV

*
5



Blanking –2.5V

*
6



Blanking –2.2V

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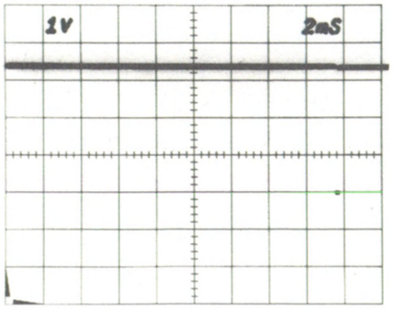

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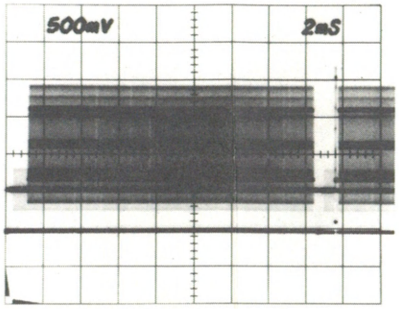

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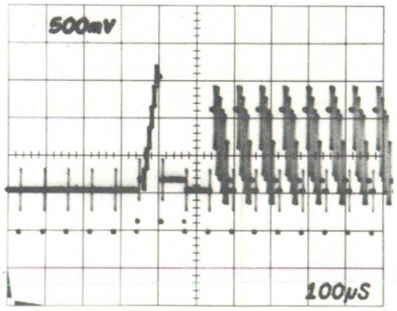

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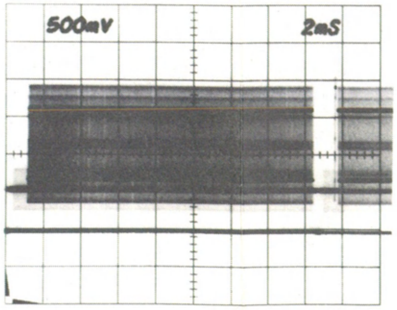


1813-50

② PARTS LOCATING CHART

DIFFERENTIAL AMP

C1331*
C1339*
C1447

Q1236
Q1340
Q1431
Q1435

R1330
R1332
R1333
R1335
R1339

R1344
R1348
R1425
R1427

R1429
R1438
R1441
R1442

FILTER SWITCHING

C1272
C1274
C1282

C1283
C1284
C1451
C1699

CR1351
CR1353
CR1355
CR1364
CR1563

R1256
R1262
R1263
R1265
R1271

R1285
R1331*
R1338*
R1345
R1349
R1352
R1354
R1361

R1362
R1363
R1365
R1366
R1367

U1347

FILTERS

C1080
C1081
C1082
C1091
C1171
C1181

C1182
C1183
C1184
C1193
C1288
C1292
C1294

C1295
C1371
C1375
C1381
C1383
C1387
C1391

L1074
L1077
L1082

L1083
L1094
L1172
L1191

L1287
L1294
L1374
L1385
L1395

R1075
R1076
R1092
R1095

R1192
R1274
R1291
R1296
R1398

VIDEO OUTPUT AMP

C1403
C1407
C1437

C1511
C1519
C1522
C1535

CR1413

Q1402
Q1421
Q1423
Q1529

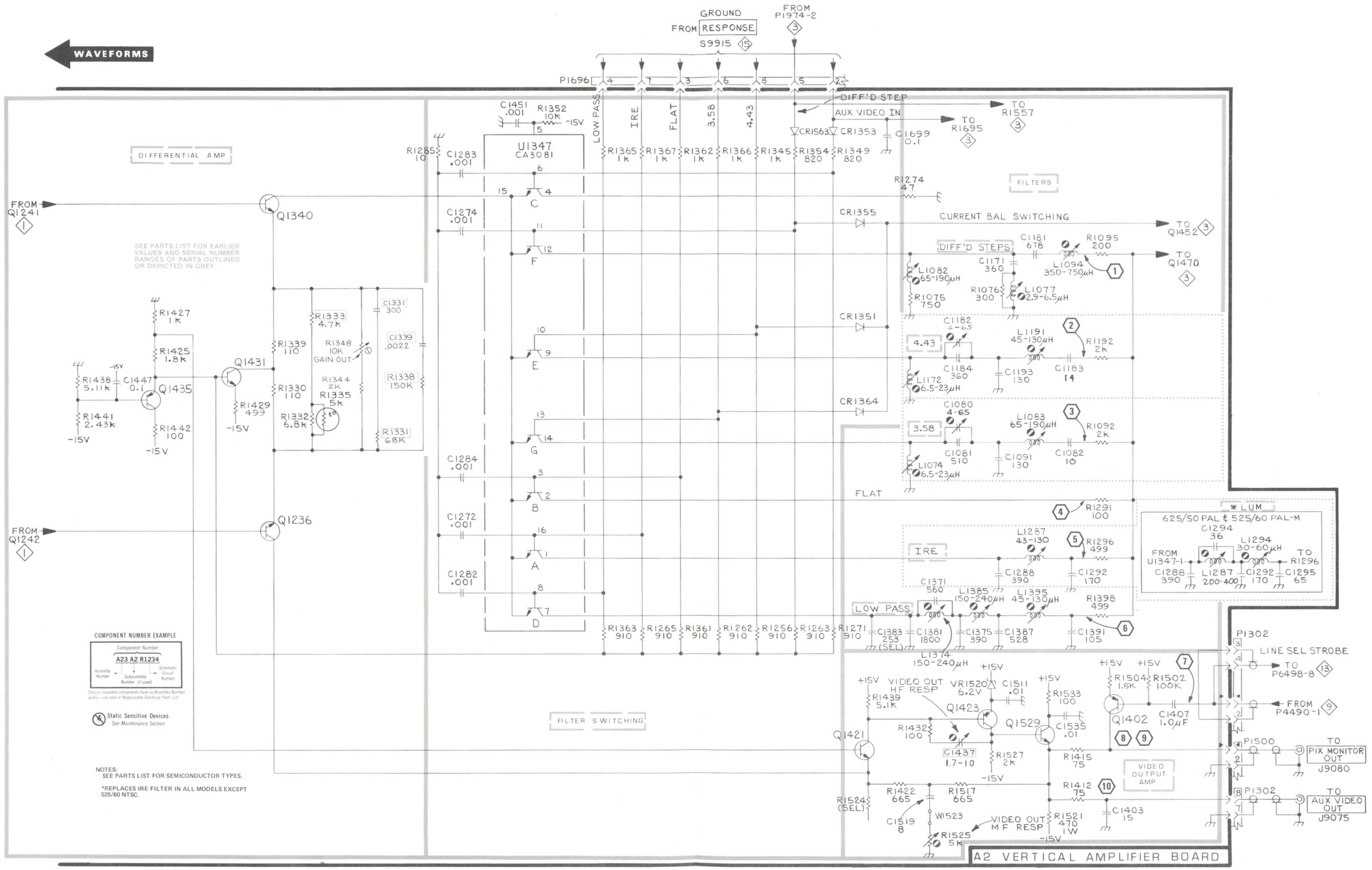
R1412
R1415
R1422
R1432

R1439
R1502
R1504
R1517

R1521
R1523
R1524
R1525
R1527
R1533

VR1520

*See Parts List for serial number ranges.


WAVEFORMS
GROUND
FROM RESPONSE S9915 ⑮
FROM P1974-2 ③
P1696
LOW PASS
IRE
FLAT
3.58
4.43
DIFF'D STEP
AUX VIDEO IN
TO R1695 ③
TO R1557 ③
DIFFERENTIAL AMP
FROM Q1241 ①
FROM Q1242 ①
Q1340
Q1236
Q1431
Q1435
U1347 CA3081
GAIN OUT
FILTERS
CURRENT BAL SWITCHING
TO Q1452 ③
TO Q1470 ③
DIFF'D STEPS
4.43
3.58
FLAT
IRE
LOW PASS
* LUM
625/50 PAL & 525/60 PAL-M
FROM U1347-1
TO R1296
FILTER SWITCHING
VIDEO OUTPUT AMP
VIDEO OUT HF RESP
VIDEO OUT MF RESP
Q1421
Q1423
Q1529
Q1402
P1302
LINE SEL STROBE
TO P6498-8 ⑬
FROM P4490-1 ⑨
P1500
TO PIX MONITOR OUT J9080
TO AUX VIDEO OUT J9075
A2 VERTICAL AMPLIFIER BOARD

SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS OUTLINED OR DEPICTED IN GREY.

COMPONENT NUMBER EXAMPLE

Component Number
A23 A2 R1234
Assembly Number — Subassembly Number (if used) — Schematic Circuit Number

Static Sensitive Devices
See Maintenance Section

NOTES:
SEE PARTS LIST FOR SEMICONDUCTOR TYPES.
*REPLACES IRE FILTER IN ALL MODELS EXCEPT 525/60 NTSC.

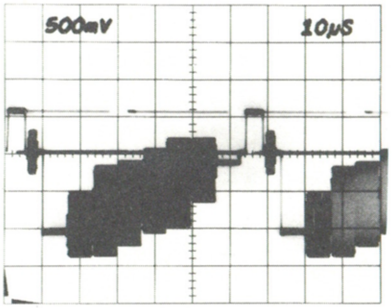
1480 SERIES (SN B060000-up)

C1813 2358-69
REV MAY 1985

FILTERS & AUX VIDEO OUT ②

3

1



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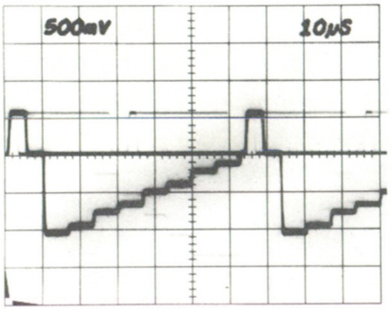

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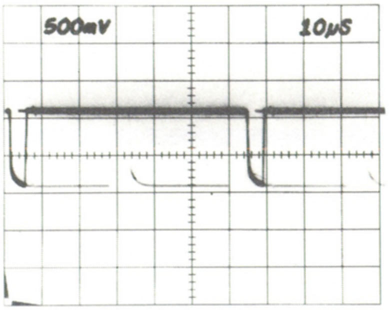


1813-51

3

PARTS LOCATING CHART

DC COUPLED FILTER CURRENT BALANCE

C1457

Q1452
Q1455

R1453
R1479
R1547
R1549
R1551
R1552

AUX VIDEO IN SWITCHING

C1493
C1687

Q1396
Q1496
Q1691

R1493
R1494
R1591
R1592

R1595
R1597
R1693
R1695

DECOUPLING

C1261
C1611
C1923
C1931

R1609

CLAMPED AMPLIFIER

C1377
C1485
C1492
C1567
C1572

C1578
C1579
C1590*
C1593
C1680

Q1472
Q1475
Q1489

R1481
R1482
R1488
R1491

R1495
R1569
R1571
R1574
R1575

R1582
R1587
R1590*

TP1379
TP1692

VR1579

W1666

DC RESTORER

C1461
C1688
C1788
C1791
C1888
C1892

CR1794

L1697

Q1465
Q1483
Q1785
Q1793
Q1891

R1476
R1477
R1478
R1487
R1555
R1557

R1558
R1577
R1581
R1584
R1586
R1685

R1688
R1786
R1787
R1789
R1797
R1885

R1887
R1891
R1893
R1894
R1895

R1896
R1899
R1992

TP1686
TP1798

U1890

GAIN CONTROL

C1666*
C1670*
C1775
C1835

C1854
C1858
C1862

C1874
C1879
C1965

CR1763
CR1765
CR1767
CR1771

CR1773
CR1774
CR1776
CR1777
CR1853

CR1865
CR1947
CR1956
CR1981
CR1987

L1662*
L1658*

Q1670A&B
Q1775
Q1847
Q1861
Q1875

R1568
R1585
R1656
R1658*
R1660
R1662*

R1664
R1666
R1681
R1684
R1762
R1768
R1769
R1779
R1781
R1830

R1844
R1877*

R1848
R1849
R1851
R1855
R1857

R1859
R1863
R1864
R1867
R1868

R1869
R1870
R1871
R1876
R1881

R1889
R1945
R1953
R1955
R1975
R1977
R1991

W1820

TONE WHEEL SYNC POSITIONING COMP

(PART OF OPTION 4 & 5)

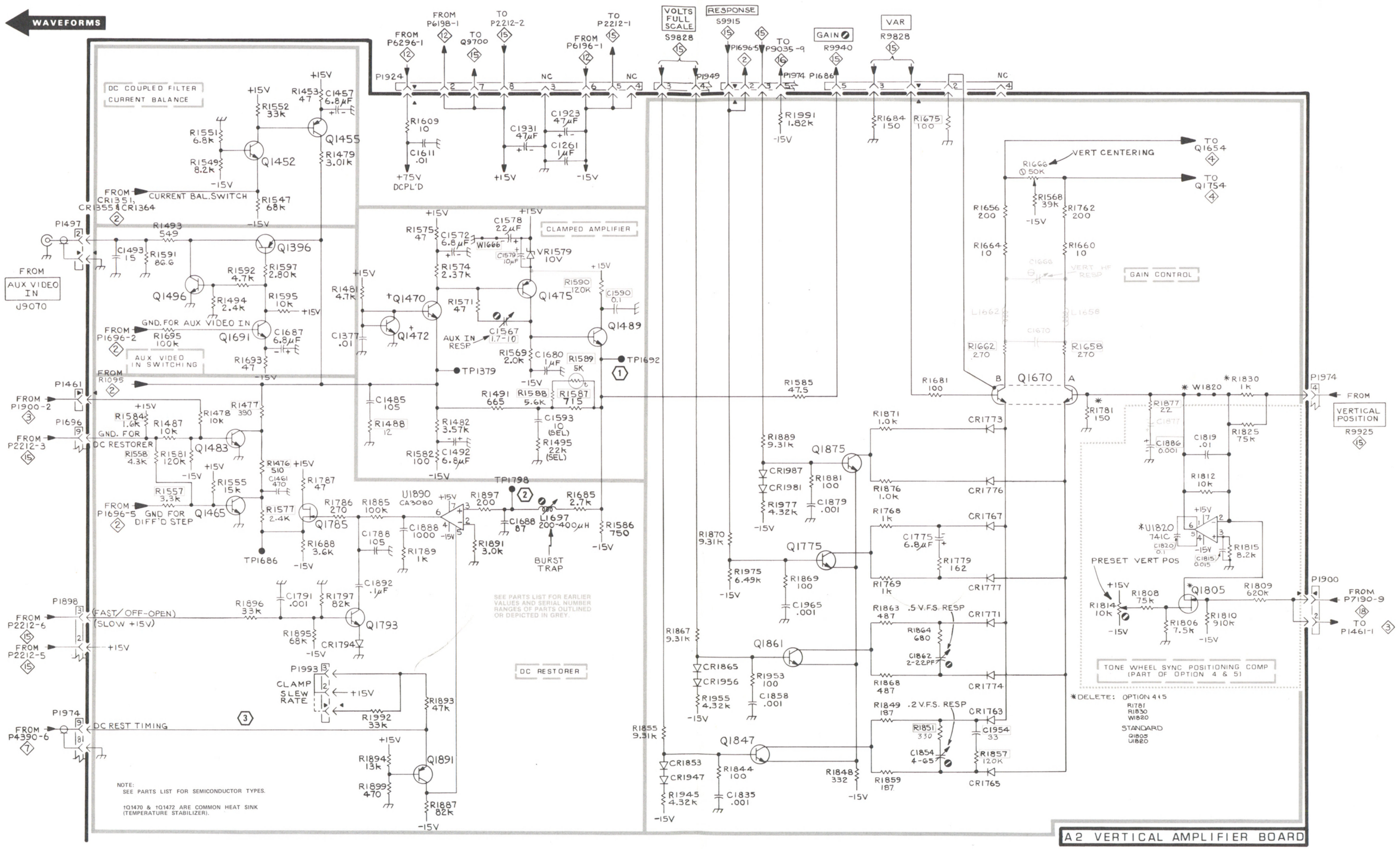
C1815
C1819
C1820
C1877
C1886
C1877*

Q1805

R1806
R1808
R1809
R1810
R1814
R1815
R1825
R1877

U1820

*See Parts List for serial number ranges.


WAVEFORMS
DC COUPLED FILTER CURRENT BALANCE
AUX VIDEO IN SWITCHING
CLAMPED AMPLIFIER
DC RESTORER
GAIN CONTROL
TONE WHEEL SYNC POSITIONING COMP (PART OF OPTION 4 & 5)
A2 VERTICAL AMPLIFIER BOARD
FROM AUX VIDEO IN J9070
FROM CR1351, CR1355 & CR1364 CURRENT BAL. SWITCH
FROM P1696-2 GND. FOR AUX VIDEO IN
FROM P1900-2
FROM P2212-3 GND. FOR DC RESTORER
FROM P1696-5 GND FOR DIFF'D STEP
FROM P2212-6 FAST/OFF-OPEN (SLOW +15V)
FROM P2212-5
FROM P4390-6 DC REST TIMING
CLAMP SLEW RATE
BURST TRAP
VERT CENTERING
TO Q1654
TO Q1754
FROM VERTICAL POSITION R9925
FROM P7190-9
TO P1461-1
PRESET VERT POS
VOLTS FULL SCALE S9828
RESPONSE S9915
GAIN R9940
VAR R9828
.5 V.F.S. RESP
.2 V.F.S. RESP
NOTE: SEE PARTS LIST FOR SEMICONDUCTOR TYPES.
†Q1470 & †Q1472 ARE COMMON HEAT SINK (TEMPERATURE STABILIZER).
SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS OUTLINED OR DEPICTED IN GREY.
*DELETE: OPTION 4 & 5
R1781
R1830
W1820
STANDARD
Q1805
U1820
Q1396
Q1452
Q1455
Q1465
Q1470
Q1472
Q1475
Q1483
Q1489
Q1496
Q1670
Q1691
Q1785
Q1775
Q1793
Q1805
Q1847
Q1861
Q1875
Q1891
U1820 741C
U1890 CA3080
TP1379
TP1686
TP1692
TP1798

1480 SERIES (SN B060000-up)

(1813)2338-70
REV MAY 1985

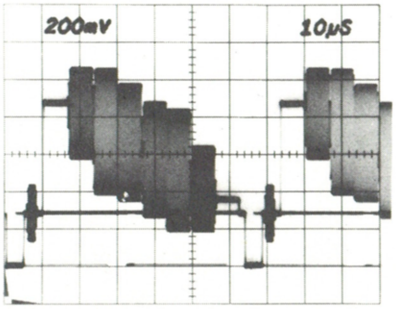
DC RESTORATION & GAIN CONTROL 3

4

* AC COUPLED

*

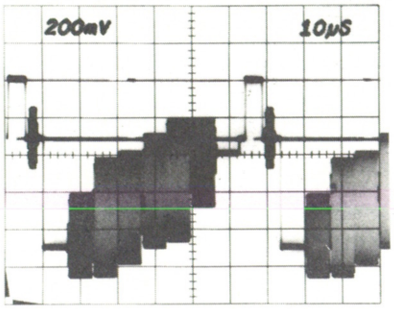
1



Peak = +12V

*

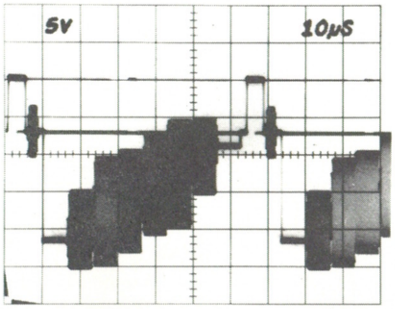
2



Sync Tip ≃ +60V

*

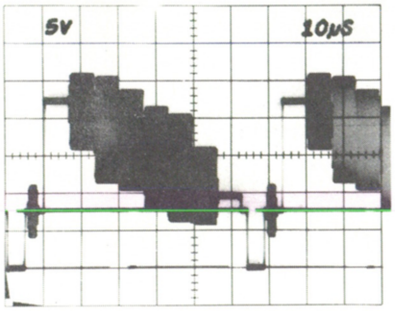
3



Sync Tip = +12

*

4



Peak ≃ +60V

④

PARTS LOCATING CHART

DEFLECTION INPUT AMPLIFIER

Q1654
Q1754

R1645
R1647
R1655
R1749

R1752
R1755
R1761

LIMITER

CR1629
CR1631
CR1633
CR1634

CR1741
CR1743
CR1744
CR1748

Q1637
Q1737
Q1747

R1625
R1627
R1628
R1634
R1635
R1735

R1738
R1739
R1745
R1751

DEFLECTION AMPLIFIER

C1626
C1712
C1727
CR1721

L1605*
L1707*

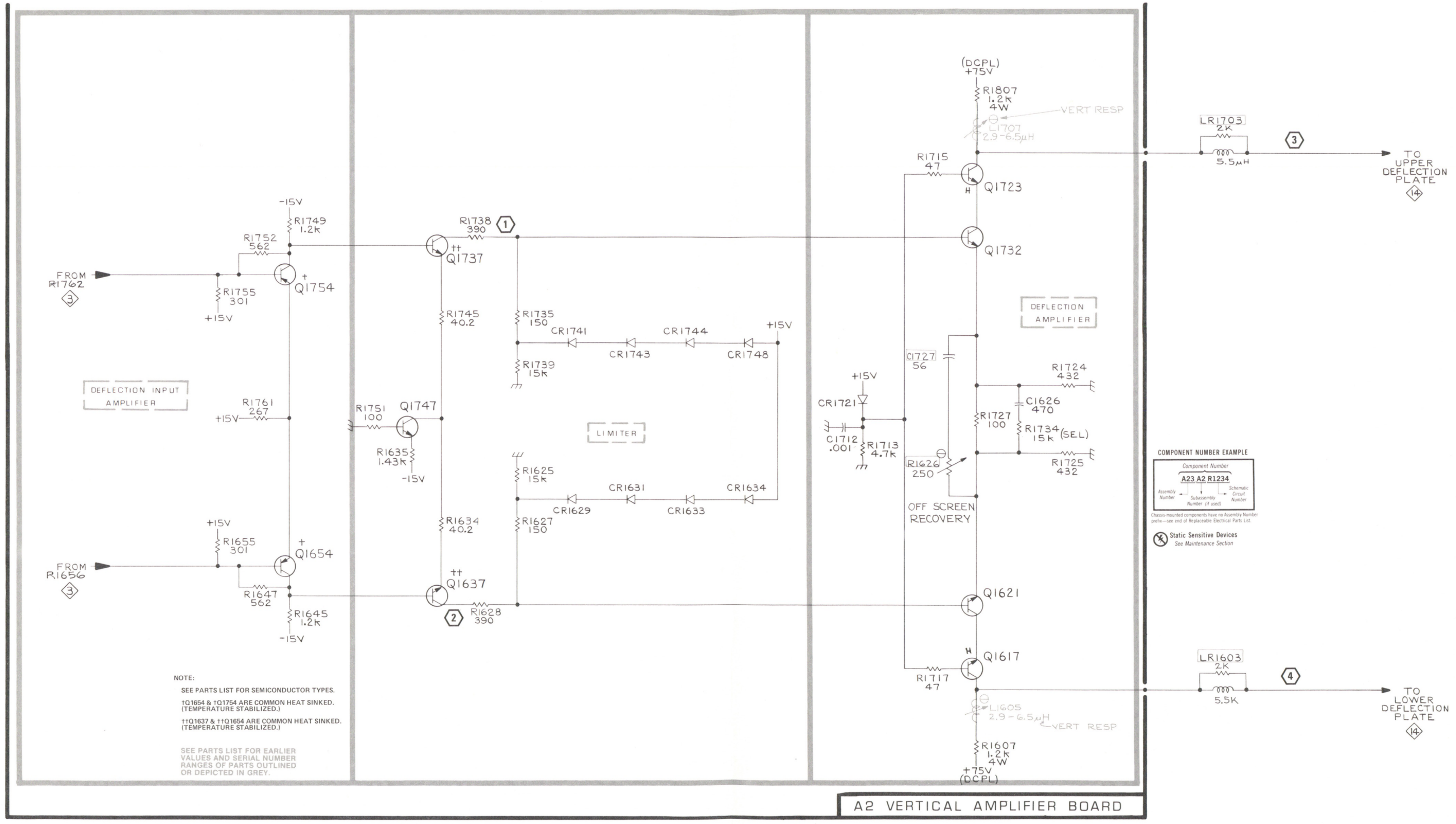
Q1617
Q1621
Q1723
Q1732

R1607
R1626
R1713
R1715
R1717
R1724

R1725
R1727
R1734
R1807

*See Parts List for serial number ranges.

WAVEFORMS


FROM R1762 ③
FROM R1656 ③
-15V
R1749 1.2k
R1752 562
Q1754
R1755 301
+15V
DEFLECTION INPUT AMPLIFIER
R1761 267
+15V
R1655 301
Q1654
R1647 562
R1645 1.2k
-15V
R1738 390 ①
Q1737
R1745 40.2
R1751 100
Q1747
R1635 1.43k
-15V
R1634 40.2
Q1637
② R1628 390
R1735 150
CR1741
CR1743
CR1744
CR1748
+15V
R1739 15k
LIMITER
R1625 15k
CR1629
CR1631
CR1633
CR1634
R1627 150
(DCPL) +75V
R1807 1.2k 4W
L1707 2.9-6.5µH
VERT RESP
R1715 47
Q1723
Q1732
DEFLECTION AMPLIFIER
C1727 56
+15V
CR1721
C1712 .001
R1713 4.7k
R1626 250
OFF SCREEN RECOVERY
R1727 100
C1626 470
R1734 15k (SEL)
R1724 432
R1725 432
Q1621
Q1617
R1717 47
L1605 2.9-6.5µH
VERT RESP
R1607 1.2k 4W
+75V (DCPL)
LR1703 2k 5.5µH ③
TO UPPER DEFLECTION PLATE ⑭
LR1603 2k 5.5k ④
TO LOWER DEFLECTION PLATE ⑭
A2 VERTICAL AMPLIFIER BOARD

NOTE:

SEE PARTS LIST FOR SEMICONDUCTOR TYPES.

†Q1654 & †Q1754 ARE COMMON HEAT SINKED. (TEMPERATURE STABILIZED.)

††Q1637 & ††Q1654 ARE COMMON HEAT SINKED. (TEMPERATURE STABILIZED.)

SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS OUTLINED OR DEPICTED IN GREY.

COMPONENT NUMBER EXAMPLE

Component Number

A23 A2 R1234

Assembly Number — *Subassembly Number (if used)* — *Schematic Circuit Number*

Chassis-mounted components have no Assembly Number prefix—see end of Replaceable Electrical Parts List.

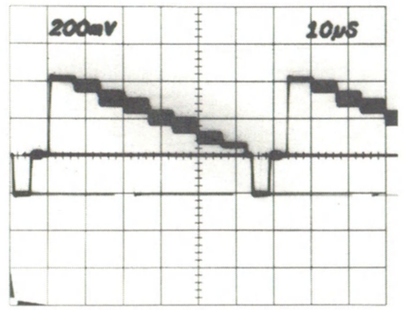
Static Sensitive Devices
See Maintenance Section

(1815) 2338-71
REV OCT 1983

5

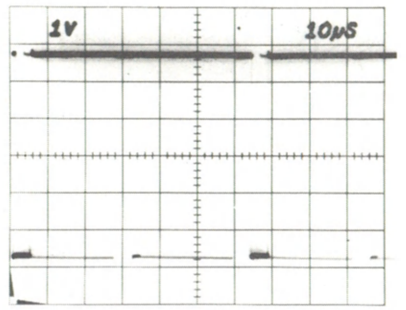
*AC COUPLED

*
1

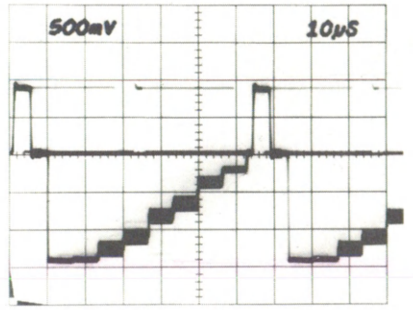


Peak = +14.4V

3

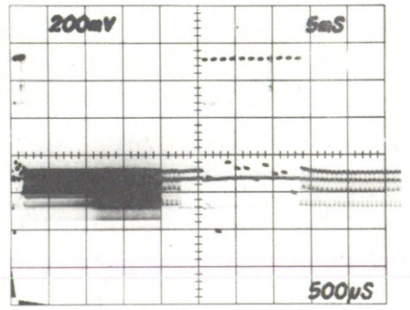


*
2



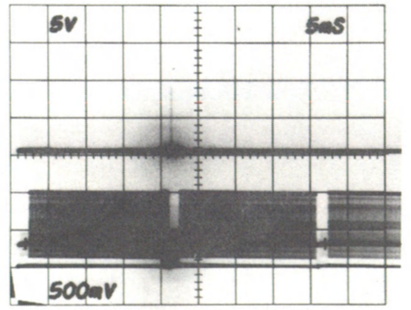
Sync Tip = +13V

*
4

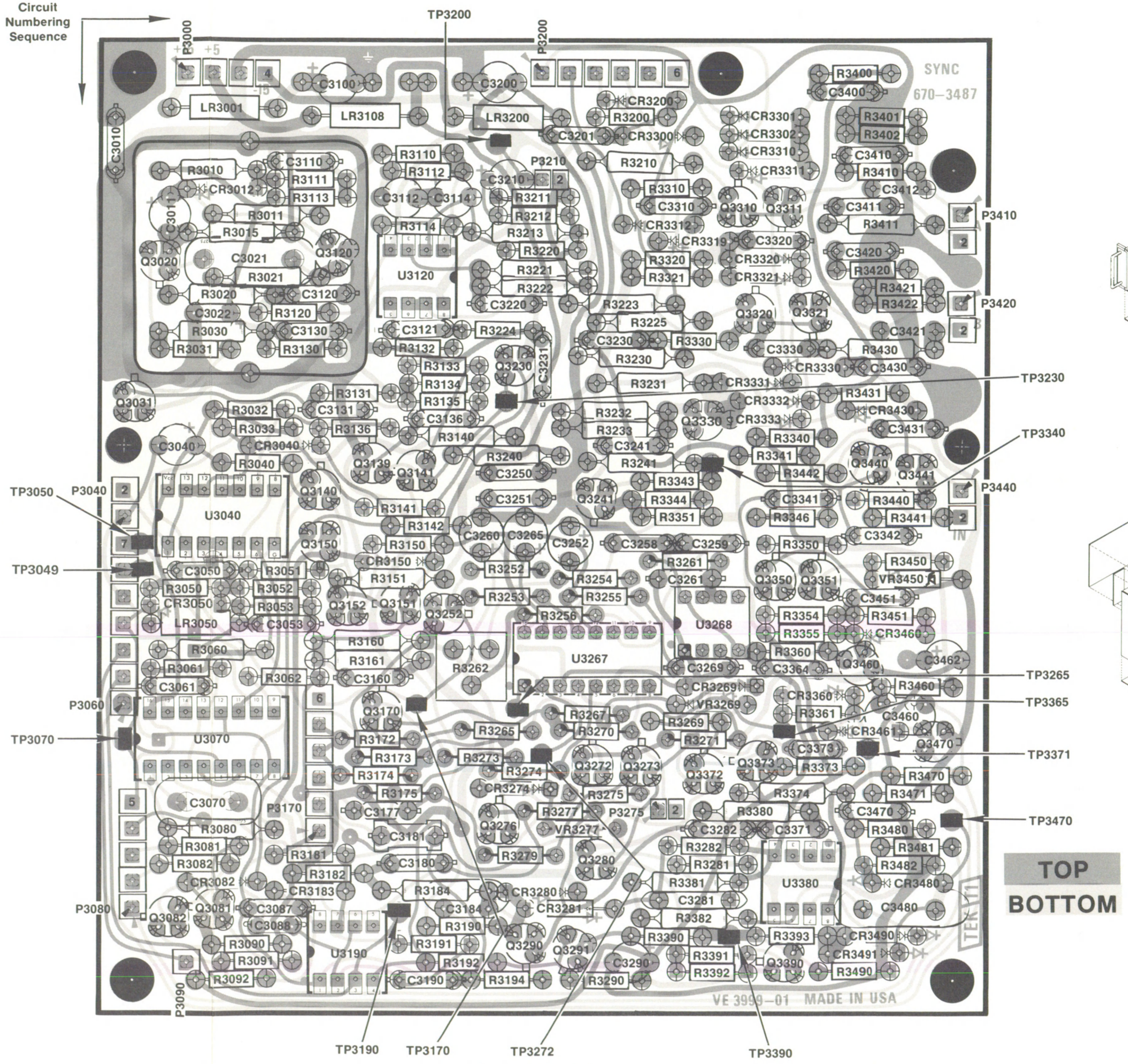


Peak = + 3.5

*
5

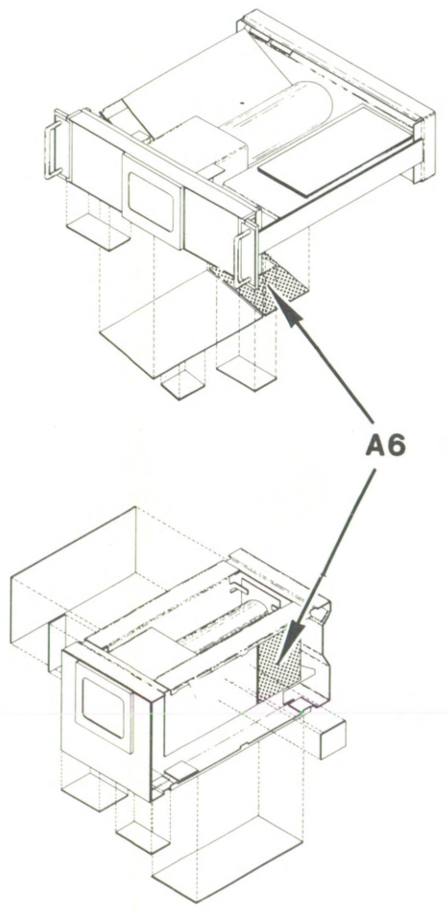


ALT TRACE, Showing Frame Pulse


Circuit Numbering Sequence
TP3200
P3000
P3200
SYNC
670-3487
LR3001
LR3108
LR3200
C3100
C3200
U3040
U3070
U3120
U3190
U3267
U3268
U3380
P3040
P3060
P3080
P3090
P3170
P3210
P3275
P3410
P3420
P3440
IN
TP3050
TP3049
TP3070
TP3230
TP3340
TP3265
TP3365
TP3371
TP3470
TP3190
TP3170
TP3272
TP3390
VE 3999-01
MADE IN USA
TOP
BOTTOM

A6 SYNC BOARD

REV B SEP 1980



5

PARTS LOCATING CHART

A SYNC INPUT

C3410
C3411

Q3310
Q3311

R3210
R3310
R3401
R3402
R3410
R3411

B SYNC INPUT

C3230
C3330
C3420

Q3320
Q3321

R3223
R3225
R3230
R3330

R3420
R3421
R3422
R3430

INT SYNC INPUT

C3431

Q3441

R3440
R3442

SYNC SWITCHING

C3201
C3310
C3320
C3400
C3430

CR3200
CR3300
CR3311
CR3312
CR3319
CR3320
CR3321

CR3330
CR3331
CR3332
CR3333
CR3430

R3200
R3320
R3321
R3400
R3431

SYNC AMPLIFIER

C3241

Q3330
Q3341

R3231
R3232
R3233
R3241

R3343
R3344
R3351

TP3340

POWER SUPPLY

C3040
C3087
C3100
C3200
C3250

C3251
C3290
C3362
C3364
C3371

LR3001
LR3108
LR3200

R3092
R3340

SYNC STRIPPER

C3258
C3259
C3260
C3265
C3269

CR3274

Q3252
Q3276

R3252
R3253
R3254
R3255
R3256

R3262
R3267
R3274
R3277
R3279

TP3170
TP3265
TP3272
TP3365

U3267

VR3277

FRAME PULSE GENERATOR

(525/60 PAL—M AND 625/50 PAL ONLY)

C3341
C3342
C3451
C3460

CR3360
CR3460
CR3461

Q3350
Q3351

Q3440
Q3460
Q3470

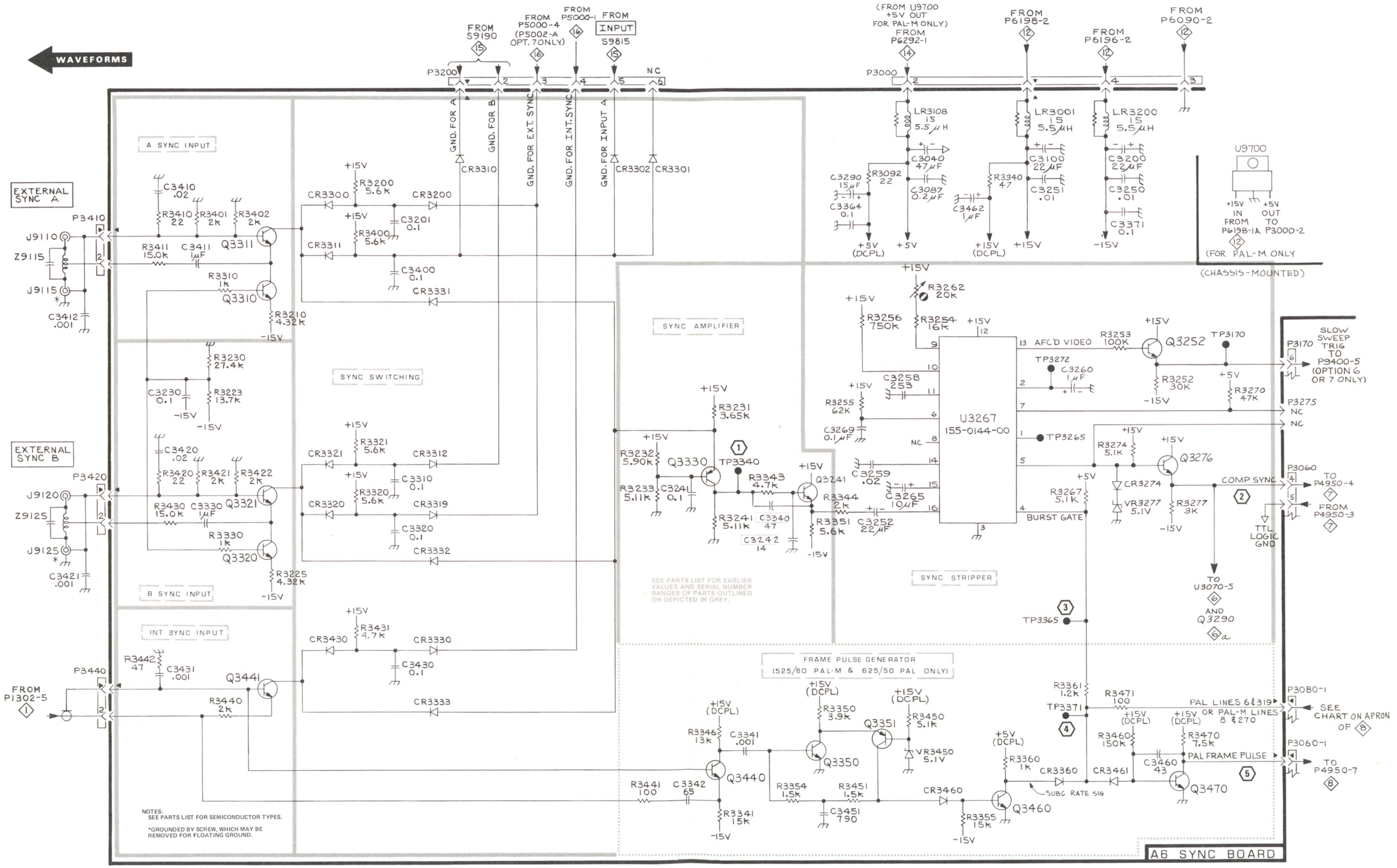
R3341
R3346
R3350
R3354
R3355

R3360
R3361
R3441
R3450
R3451

R3460
R3470
R3471

TP3371

VR3450

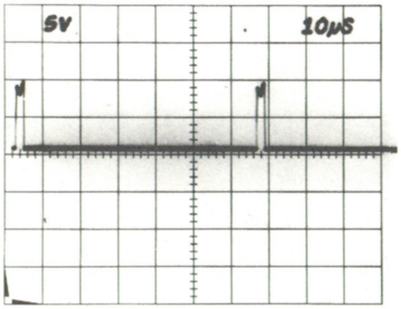


WAVEFORMS
FROM S9190 15
FROM P5000-4 (P5002-A OPT. 7 ONLY) 16
FROM P5000-1 14
FROM INPUT S9815 15
NC
P3200
GND. FOR A
GND. FOR B
GND. FOR EXT. SYNC
GND. FOR INT. SYNC
GND. FOR INPUT A
(FROM U9700 +5V OUT FOR PAL-M ONLY) FROM P6292-1 14
FROM P6198-2 12
FROM P6196-2 12
FROM P6090-2 12
P3000
LR3108 15 5.5µH
LR3001 15 5.5µH
LR3200 15 5.5µH
C3290 15µF
R3092 22
C3040 47µF
C3087 0.2µF
C3364 0.1
R3340 47
C3462 1µF
C3100 22µF
C3251 .01
C3200 22µF
C3250 .01
C3371 0.1
+5V (DCPL)
+5V
+15V (DCPL)
+15V
-15V
U9700
+15V IN FROM P6198-1A 12
+5V OUT TO P3000-2
(FOR PAL-M ONLY)
(CHASSIS-MOUNTED)
EXTERNAL SYNC A
P3410
J9110
Z9115
J9115
C3412 .001
A SYNC INPUT
C3410 .02
R3410 22
R3401 2K
R3402 2K
R3411 15.0K
C3411 1µF
Q3311
R3310 1K
Q3310
R3210 4.32K
-15V
R3230 27.4K
C3230 0.1
R3223 13.7K
EXTERNAL SYNC B
P3420
J9120
Z9125
J9125
C3421 .001
C3420 .02
R3420 22
R3421 2K
R3422 2K
R3430 15.0K
C3330 1µF
Q3321
R3330 1K
Q3320
R3225 4.32K
B SYNC INPUT
INT SYNC INPUT
R3442 47
C3431 .001
P3440
FROM P1302-5 1
Q3441
R3440 2K
NOTES:
SEE PARTS LIST FOR SEMICONDUCTOR TYPES.
*GROUNDED BY SCREW, WHICH MAY BE REMOVED FOR FLOATING GROUND.
+15V
R3200 5.6K
CR3300
CR3200
CR3310
R3400 5.6K
C3201 0.1
CR3311
C3400 0.1
CR3331
CR3302
CR3301
SYNC SWITCHING
R3321 5.6K
CR3321
CR3312
R3320 5.6K
C3310 0.1
CR3320
CR3319
C3320 0.1
CR3332
R3431 4.7K
CR3430
CR3330
C3430 0.1
CR3333
SYNC AMPLIFIER
R3231 3.65K
R3232 5.90K
Q3330
TP3340 1
R3233 5.11K
C3241 0.1
R3343 4.7K
Q3241
R3344 2K
R3241 5.11K
C3340 47
C3242 14
R3351 5.6K
SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS OUTLINED OR DEPICTED IN GREY.
R3262 20K
R3256 750K
R3254 16K
C3258 253
R3255 62K
C3269 0.1µF
C3259 .02
C3265 10µF
C3252 22µF
U3267 155-0144-00
AFC'D VIDEO
R3253 100K
Q3252
TP3170
TP3272
C3260 1µF
R3252 30K
R3270 47K
TP3265
R3274 5.1K
Q3276
CR3274
VR3277 5.1V
R3267 5.1K
R3277 3K
BURST GATE
SYNC STRIPPER
P3170
SLOW SWEEP TRIG TO P9400-5 (OPTION 6 OR 7 ONLY)
P3275
NC
P3060
COMP SYNC 2
TO P4950-4 7
FROM P4950-3 7
TTL LOGIC GND
TO U3070-5 6 AND Q3290 6
TP3365 3
FRAME PULSE GENERATOR (525/60 PAL-M & 625/50 PAL ONLY)
R3361 1.2K
TP3371 4
R3471 100
P3080-1
PAL LINES 6 & 319 OR PAL-M LINES 8 & 270
SEE CHART ON APRON OF 8
R3346 13K
C3341 .001
R3350 3.9K
Q3351
R3450 5.1K
VR3450 5.1V
Q3350
R3460 150K
R3470 7.5K
C3460 43
PAL FRAME PULSE 5
P3060-1
TO P4950-7 8
Q3440
R3441 100
C3342 65
R3341 15K
R3354 1.5K
R3451 1.5K
C3451 790
R3360 1K
CR3360
CR3461
SUBC RATE 5/4
CR3460
Q3460
R3355 15K
Q3470
A6 SYNC BOARD

(1813) 2338-72
REV FEB 1982

6

1



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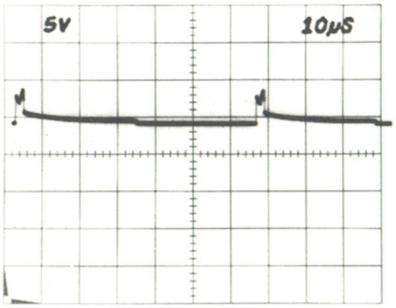

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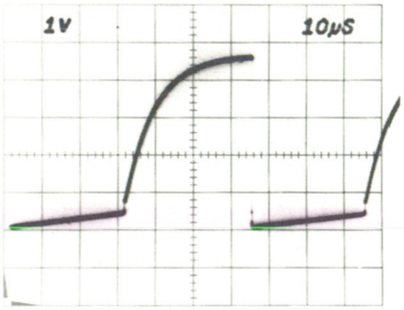
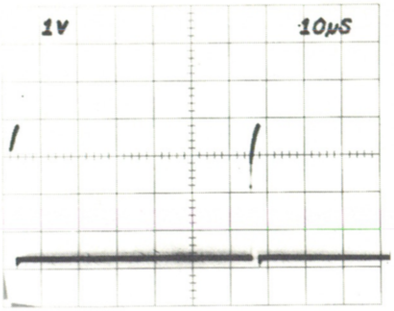


AC COUPLED

4



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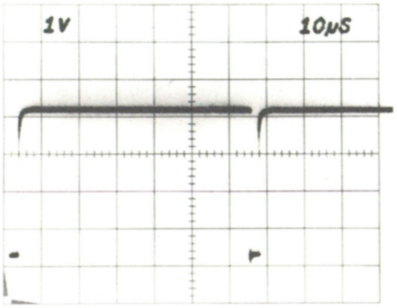


6

PARTS LOCATING CHART

31 KHz LOCKOUT

- C3070
- R3080
- R3134
- R3135
- U3070A

AFC DIRECT SWITCHING

- C3050
- C3136
- CR3040
- CR3050
- Q3139
- Q3150
- Q3230
- R3033
- R3050
- R3052
- R3140
- R3141
- R3142
- R3240
- U3040A
- U3040D
- U3040C

ERROR AMPLIFIER

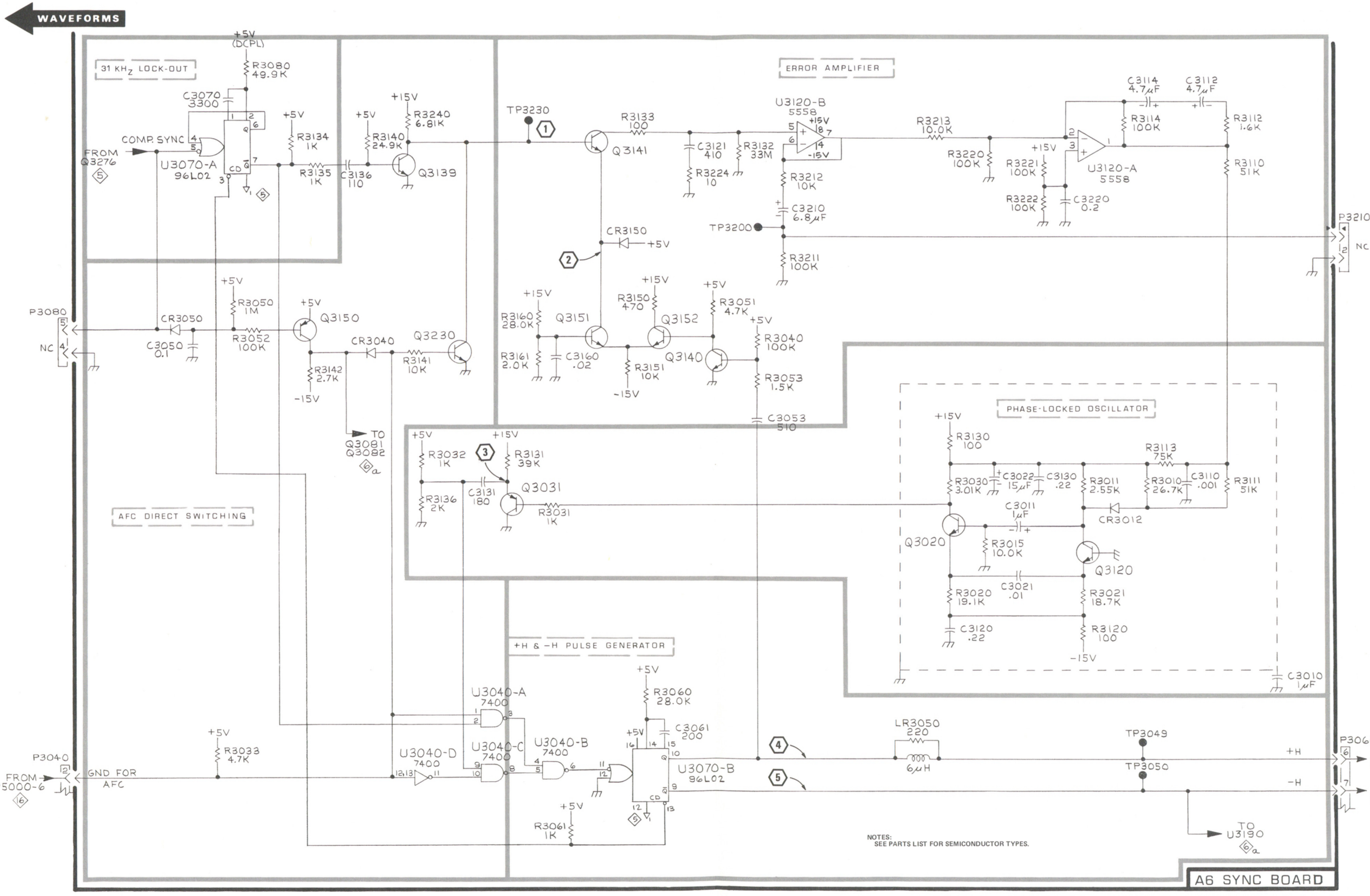
- C3053
- C3112
- C3114
- C3121
- C3160
- C3210
- C3220
- CR3150
- Q3140
- Q3141
- Q3151
- Q3152
- R3040
- R3051
- R3053
- R3110
- R3112
- R3114
- R3132
- R3133
- R3150
- R3151
- R3160
- R3161
- R3211
- R3212
- R3213
- R3220
- R3221
- R3222
- R3224
- TP3200
- U3120A
- U3120B

PHASE-LOCKED OSCILLATOR

- C3010
- C3011
- C3021
- C3022
- C3110
- C3120
- C3130
- C3131
- CR3012
- Q3020
- Q3031
- Q3120
- R3010
- R3011
- R3015
- R3020
- R3021
- R3030
- R3031
- R3032
- R3111
- R3113
- R3120
- R3130
- R3131
- R3136

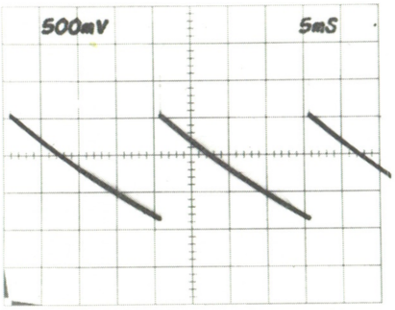
+H & −H PULSE GENERATOR

- C3061
- LR3050
- R3060
- R3061
- TP3049
- TP3050
- U3040B
- U3070B


WAVEFORMS
31 KHz LOCK-OUT
ERROR AMPLIFIER
AFC DIRECT SWITCHING
PHASE-LOCKED OSCILLATOR
+H & −H PULSE GENERATOR
+5V (DCPL)
R3080 49.9K
C3070 3300
COMP. SYNC
FROM Q3276
U3070-A 96L02
R3134 1K
R3135 1K
C3136 110
R3140 24.9K
R3240 6.81K
Q3139
TP3230
R3133 100
Q3141
C3121 410
R3132 33M
R3224 10
U3120-B 5558
R3212 10K
C3210 6.8µF
TP3200
R3211 100K
R3213 10.0K
R3220 100K
R3221 100K
R3222 100K
C3220 0.2
C3114 4.7µF
C3112 4.7µF
R3114 100K
R3112 1.6K
R3110 51K
U3120-A 5558
P3210
NC
CR3150
R3160 28.0K
R3161 2.0K
C3160 .02
Q3151
R3150 470
Q3152
R3151 10K
R3051 4.7K
Q3140
R3040 100K
R3053 1.5K
C3053 510
P3080
NC
CR3050
C3050 0.1
R3050 1M
R3052 100K
Q3150
R3142 2.7K
CR3040
R3141 10K
Q3230
TO Q3081 Q3082
R3032 1K
R3131 39K
C3131 180
Q3031
R3136 2K
R3031 1K
R3130 100
R3030 3.01K
C3022 15µF
C3130 .22
R3011 2.55K
R3113 75K
R3010 26.7K
C3110 .001
R3111 51K
C3011 1µF
CR3012
Q3020
R3015 10.0K
Q3120
R3020 19.1K
C3021 .01
R3021 18.7K
C3120 .22
R3120 100
−15V
C3010 1µF
P3040
FROM P5000-6
GND FOR AFC
R3033 4.7K
U3040-D 7400
U3040-A 7400
U3040-C 7400
U3040-B 7400
R3060 28.0K
C3061 200
U3070-B 96L02
R3061 1K
LR3050 220 6µH
TP3049
TP3050
P3060
+H
−H
TO P4950-2
TO P4950-1
TO U3190
NOTES: SEE PARTS LIST FOR SEMICONDUCTOR TYPES.
A6 SYNC BOARD

6a

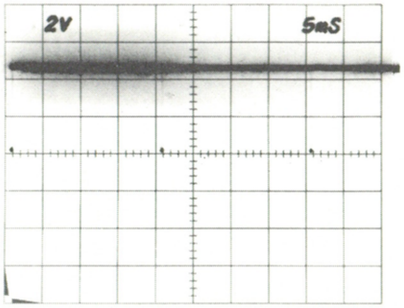
1



Neg Peak = –5.6V

AC COUPLED

2



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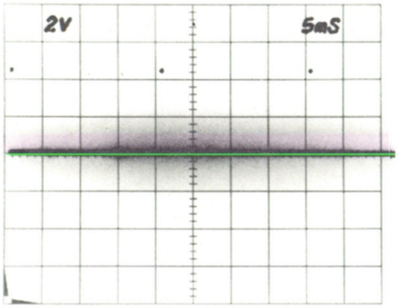

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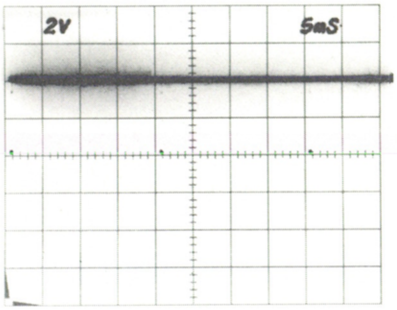


⟨6⟩a

PARTS LOCATING CHART

FIELD SYNC GENERATOR

C3088
C3180
C3181
C3184
C3190
C3281

CR3280
CR3281

Q3280
Q3290
Q3291
Q3390

R3062
R3181
R3182
R3183
R3184

R3190
R3191
R3192
R3194
R3281

R3282
R3290
R3390
R3391
R3392
R3490

50-60 Hz TRIGGER INPUT AMPLIFIER

C3177
C3261
C3373

Q3272
Q3273
Q3373

R3173
R3174
R3175
R3261
R3269

R3271
R3275
R3279
R3373

U3268

FIELD SYNC GENERATOR

CR3269

Q3170

R3172
R3265
R3273

VR3269

50-60 Hz RECOGNITION

(525/60 NTSC & 625/50 PAL DUAL-STANDARD MODELS ONLY)

C3282
C3470
C3480

CR3082
CR3480
CR3490
CR3491

Q3081
Q3082

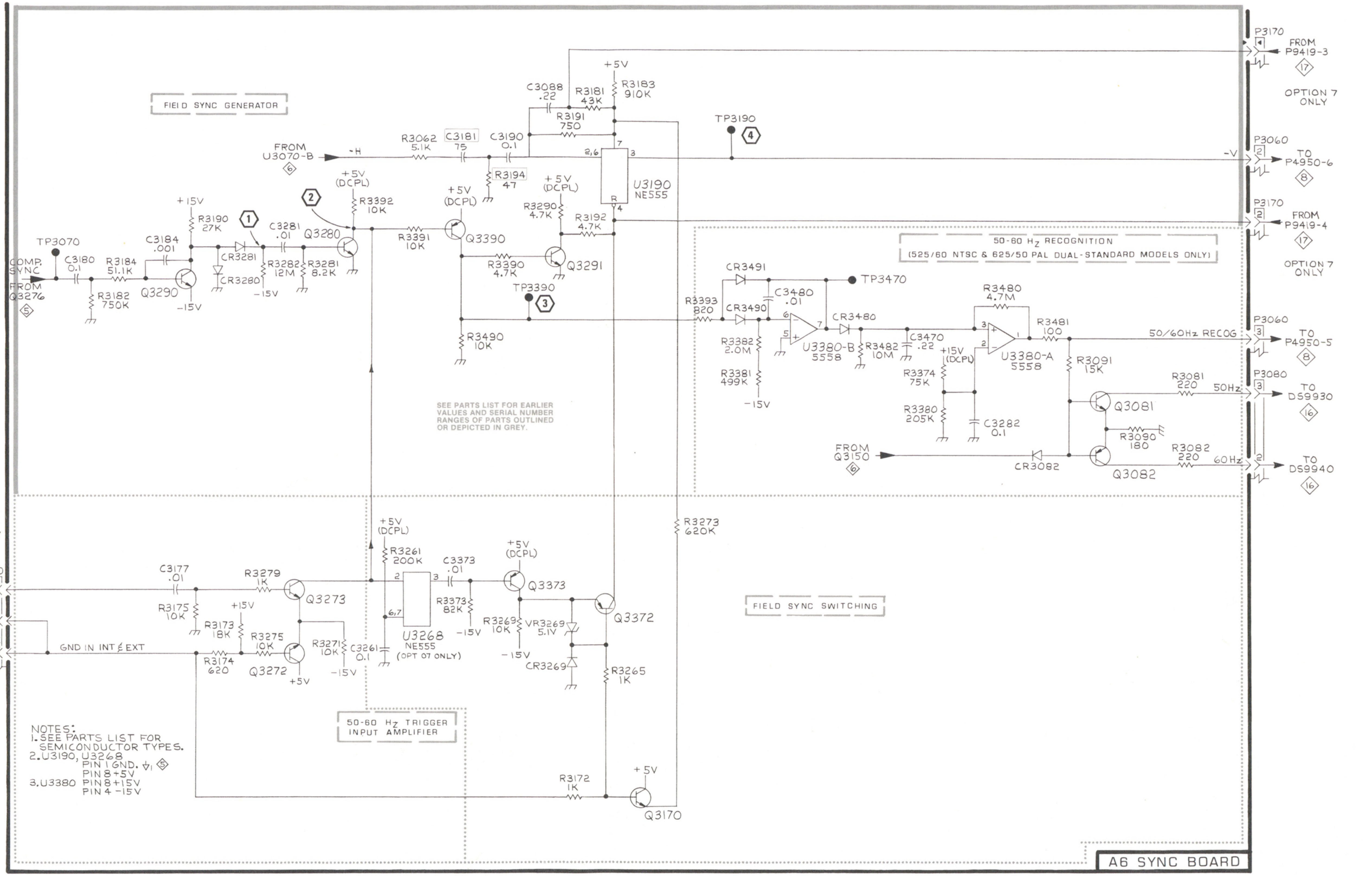
R3081
R3082
R3090
R3091
R3374

R3380
R3381
R3382
R3393
R3480
R3481
R3482

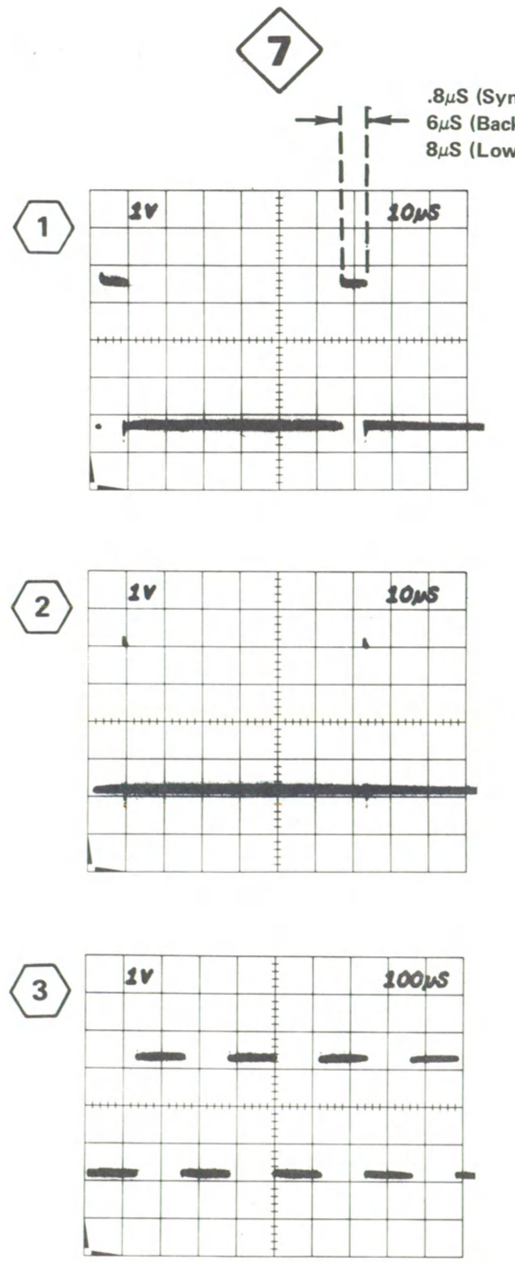
TP3470

U3380A
U3380B

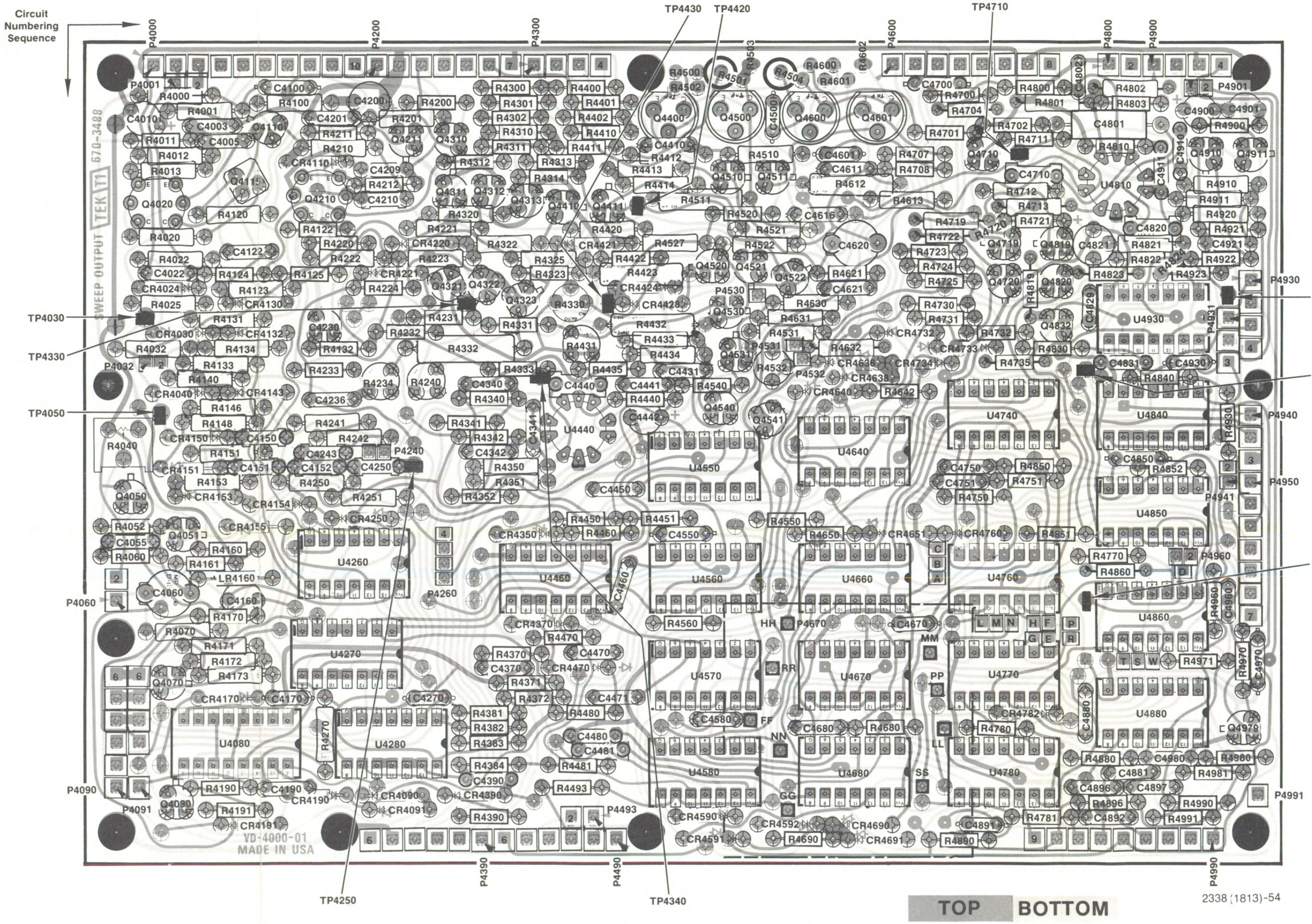
WAVEFORMS


FIELD SYNC GENERATOR
50-60 Hz RECOGNITION
(525/60 NTSC & 625/50 PAL DUAL-STANDARD MODELS ONLY)
FIELD SYNC SWITCHING
50-60 Hz TRIGGER INPUT AMPLIFIER
AUX. SYNC INPUT
OPTION 7 ONLY 50/60 Hz EXT/SYNC
GND IN INT & EXT
FROM U3070-B
FROM Q3276
FROM Q3150
FROM P5002-B
TO P4931-3
COMP. SYNC
P3170
FROM P9419-3
OPTION 7 ONLY
P3060
TO P4950-6
FROM P9419-4
TO P4950-5
P3080
TO DS9930
TO DS9940
50/60Hz RECOG
50Hz
60Hz
-V
+H
TP3070
TP3190
TP3390
TP3470
U3190 NE555
U3268 NE555 (OPT 07 ONLY)
U3380-A 5558
U3380-B 5558
Q3170
Q3081
Q3082
Q3273
Q3272
Q3280
Q3290
Q3291
Q3373
Q3372
Q3390
CR3281
CR3280
CR3491
CR3490
CR3480
CR3082
CR3269
VR3269 5.1V
C3088 .22
C3180 0.1
C3181 75
C3184 .001
C3190 0.1
C3281 .01
C3480 .01
C3470 .22
C3282 0.1
C3177 .01
C3261 0.1
C3373 .01
R3062 5.1K
R3181 43K
R3183 910K
R3191 750
R3194 47
R3192 4.7K
R3290 4.7K
R3190 27K
R3392 10K
R3391 10K
R3390 4.7K
R3490 10K
R3184 51.1K
R3182 750K
R3282 12M
R3281 8.2K
R3393 820
R3382 2.0M
R3381 499K
R3482 10M
R3374 75K
R3380 205K
R3480 4.7M
R3481 100
R3091 15K
R3081 220
R3090 180
R3082 220
R3273 620K
R3261 200K
R3373 82K
R3269 10K
R3265 1K
R3279 1K
R3175 10K
R3173 18K
R3275 10K
R3271 10K
R3174 620
R3172 1K
+5V
+5V (DCPL)
+15V
+15V (DCPL)
-15V
SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS OUTLINED OR DEPICTED IN GREY.
A6 SYNC BOARD

NOTES:
1. SEE PARTS LIST FOR SEMICONDUCTOR TYPES.
2. U3190, U3268 PIN 1 GND. PIN 8 +5V
3. U3380 PIN 8 +15V PIN 4 -15V



CAL Pressed. Test Oscilloscope, INT TRIG


Circuit Numbering Sequence
P4000
P4200
P4300
P4600
P4800
P4900
TP4430
TP4420
TP4710
TP4030
TP4330
TP4050
TP4925
TP4830
TP4860
P4060
P4090
P4930
P4940
P4950
P4991
P4390
P4490
P4990
TP4250
TP4340
670-3488
SWEEP OUTPUT
TEK
VD-4000-01
MADE IN USA
U4260
U4270
U4280
U4080
U4440
U4450
U4550
U4560
U4570
U4580
U4640
U4660
U4670
U4680
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U4780
U4810
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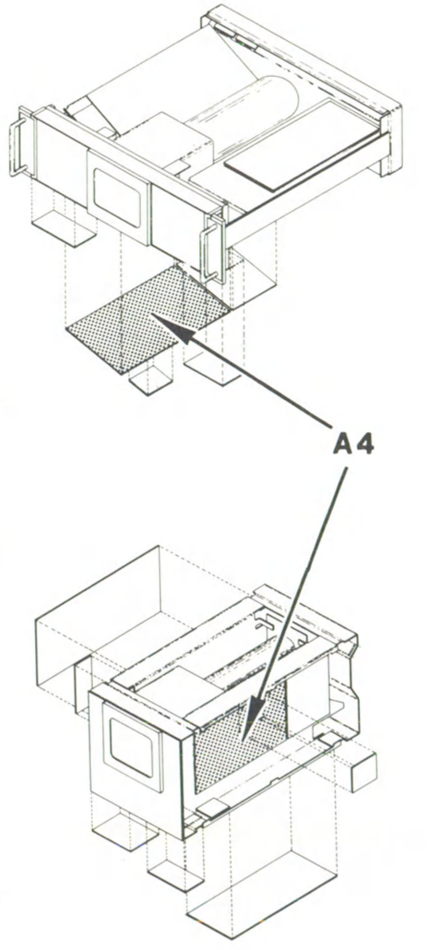
U4860
U4880
U4930
2338 (1813)-54



TOP **BOTTOM**

A4 SWEEP OUTPUT BOARD

REV B SEP 1980

7

PARTS LOCATING CHART

DC RESTORER TIMING LOGIC

- C4170
- C4190
- C4390

- CR4090
- CR4091
- CR4170
- CR4190
- CR4191
- CR4390

- Q4070
- Q4090

- R4170
- R4171
- R4172
- R4173
- R4190

- R4191
- R4270
- R4383
- R4384
- R4390
- R4560

- U4080A
- U4080B
- U4080C
- U4080D

CALIBRATOR TIMING LOGIC

- R4550
- R4730

POWER SUPPLY & DECOUPLING

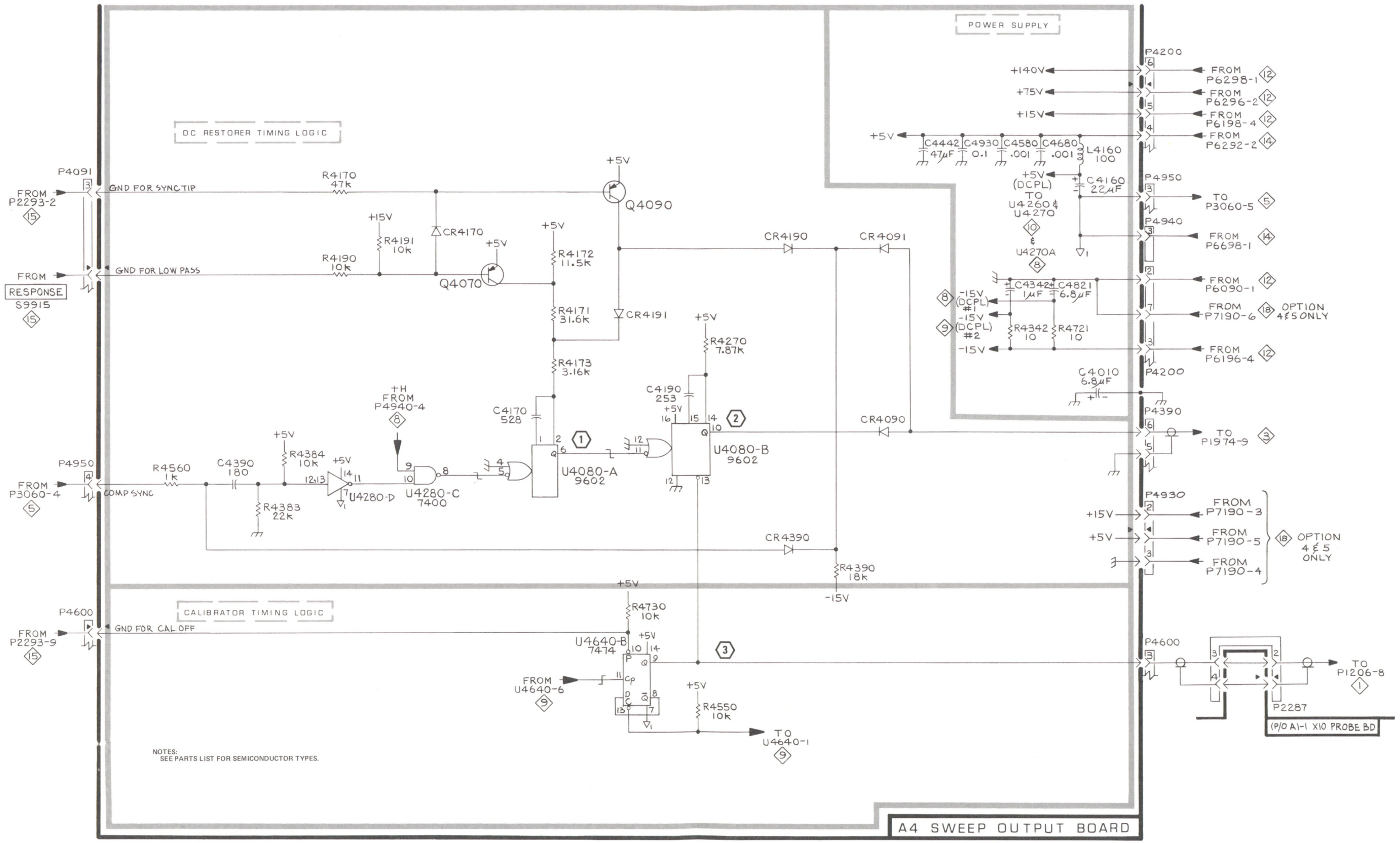
- C4010
- C4160
- C4342

- C4442
- C4580
- C4680
- C4821
- C4830

- L4160

- R4342
- R4721

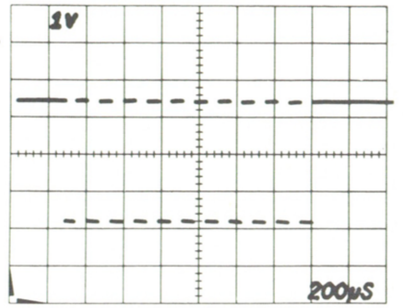
WAVEFORMS


DC RESTORER TIMING LOGIC
P4091
FROM P2293-2 15
GND FOR SYNC TIP
FROM RESPONSE S9915 15
GND FOR LOW PASS
R4170 47k
+15V
R4191 10k
CR4170
R4190 10k
Q4070
+5V
Q4090
R4172 11.5k
R4171 31.6k
CR4191
R4173 3.16k
C4170 528
+H FROM P4940-4 8
P4950
FROM P3060-4 5
COMP SYNC
R4560 1k
C4390 180
R4384 10k
R4383 22k
U4280-D
U4280-C 7400
U4080-A 9602
1
2
C4190 253
R4270 7.87k
U4080-B 9602
CR4190
CR4091
CR4090
CR4390
R4390 18k
-15V
POWER SUPPLY
P4200
+140V
+75V
FROM P6298-1 12
FROM P6296-2 12
FROM P6198-4 12
FROM P6292-2 14
C4442 47μF
C4930 0.1
C4580 .001
C4680 .001
L4160 100
+5V (DCPL) TO U4260 & U4270 10 & U4270A 8
C4160 22μF
P4950
TO P3060-5 5
P4940
FROM P6698-1 14
C4342 1μF
C4821 6.8μF
-15V (DCPL) #1 8
-15V (DCPL) #2 9
R4342 10
R4721 10
FROM P6090-1 12
FROM P7190-6 18 OPTION 4&5 ONLY
FROM P6196-4 12
C4010 6.8μF
P4390
TO P1974-9 3
P4930
FROM P7190-3
FROM P7190-5
FROM P7190-4
18 OPTION 4&5 ONLY
CALIBRATOR TIMING LOGIC
P4600
FROM P2293-9 15
GND FOR CAL OFF
R4730 10k
U4640-B 7474
FROM U4640-6 9
3
R4550 10k
TO U4640-1 9
P4600
P2287
TO P1206-8 1
(P/O A1-1 X10 PROBE BD)
A4 SWEEP OUTPUT BOARD

NOTES:
SEE PARTS LIST FOR SEMICONDUCTOR TYPES.

(1813)2338-75
REV OCT 1983

8

1


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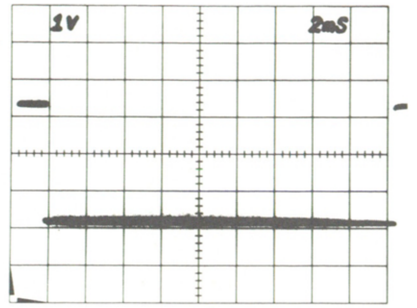

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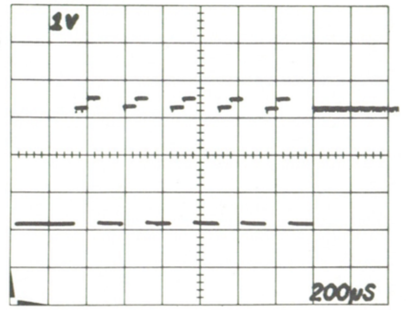

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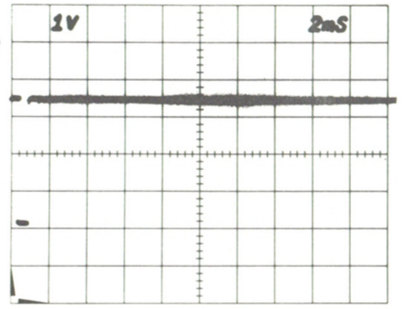

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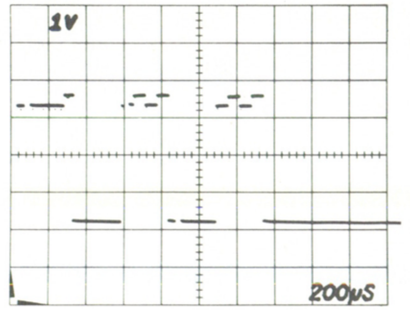

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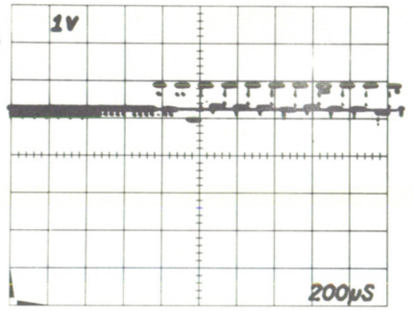

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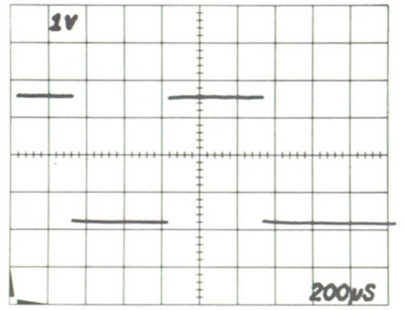

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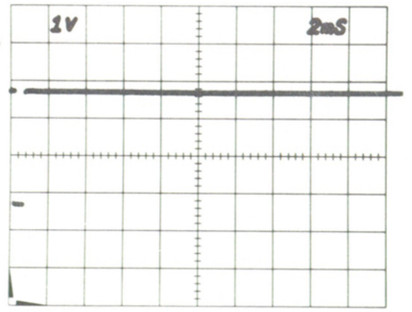

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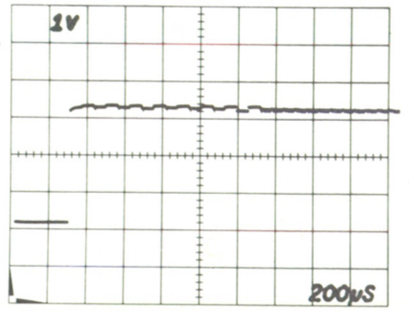

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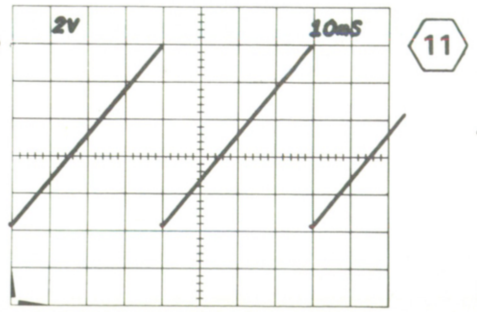

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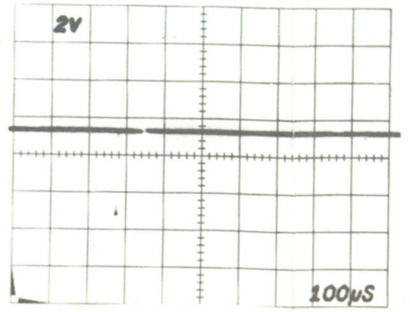
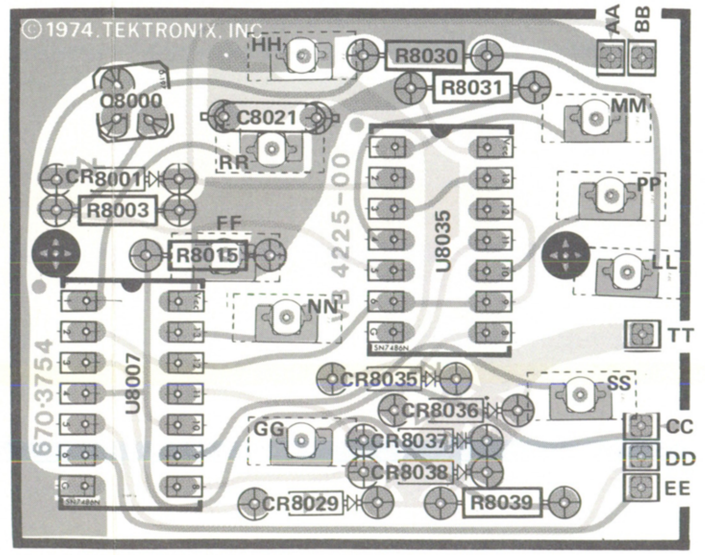
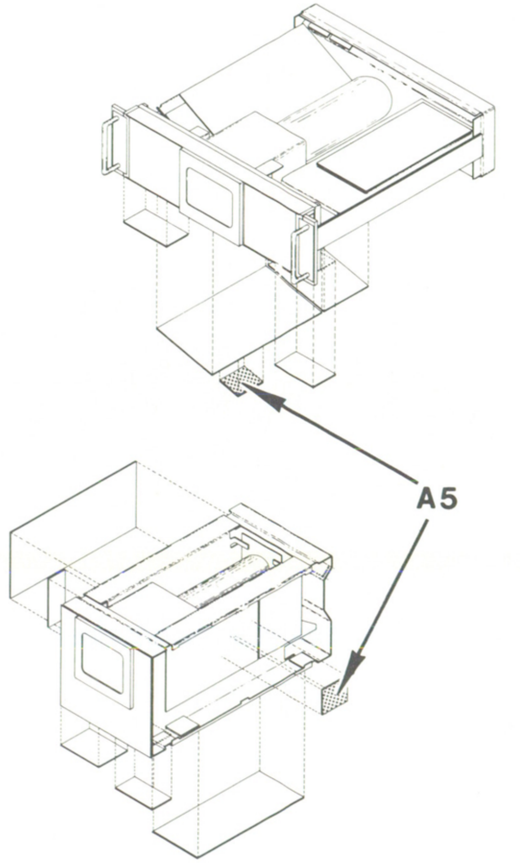


TOP
BOTTOM


©1974 TEKTRONIX, INC
HH
R8030
R8031
AA
BB
Q8000
C8021
MM
RR
CR8001
R8003
PP
FF
R8015
LL
NN
670-3754
U8007
U8035
670-4225-00
SN7486N
TT
CR8035
CR8036
SS
GG
CR8037
CC
DD
CR8038
EE
CR8029
R8039

A5 PAL-M LINE COUNTER BOARD



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(1813) 2338-55

⟨8⟩

PARTS LOCATING CHART

FIELD RECOGNITION

C4891

CR4651
CR4760

R4780
R4851
R4860
R4930
R4971

TP4860

U4770A
U4780D
U4850C
U4850D
U4860A

FRAME RECOGNITION

C4850
C4970
C4980

R4650
R4852
R4960
R4981

U4660B
U4760A
U4760B
U4850A
U4860B

LINE COUNTER

C4471
C4861
C4880
C4891

CR4782

Q4860

R4371
R4372
R4770
R4861

R4890
R4970
R4990

U4270A
U4460C
U4570A
U4570B
U4580A
U4670A

U4670B
U4670D
U4770B
U4770C
U4880B

FIELD GATE

C4670

CR4590
CR4591
CR4592
CR4690
CR4691

R4680
R4690
R4980

U4760C
U4770D
U4880A
U4880C

FIELD SWEEP GENERATOR

C4710
C4801
C4802
C4820
C4831

C4910
C4911

Q4710
Q4719
Q4720
Q4819
Q4820
Q4832

R4700
R4702
R4704
R4711
R4712

R4713
R4719
R4720
R4722
R4724
R4732

R4735
R4800
R4801
R4802
R4803

R4810
R4821
R4822
R4824
R4830
R4831

R4832
R4840
R4922

TP4710
TP4920

U4810
U4840A
U4850B
U4930C
U4930D

PAL-M COUNT RECOGNITION

C8021

CR8001
CR8029
CR8035
CR8036
CR8037
CR8038

Q8000

R8003
R8015
R8030
R8031
R8039

U8007A
U8007B
U8007C
U8007D

U8035A
U8035B
U8035C
U8035D

INPUT AMPLIFIER

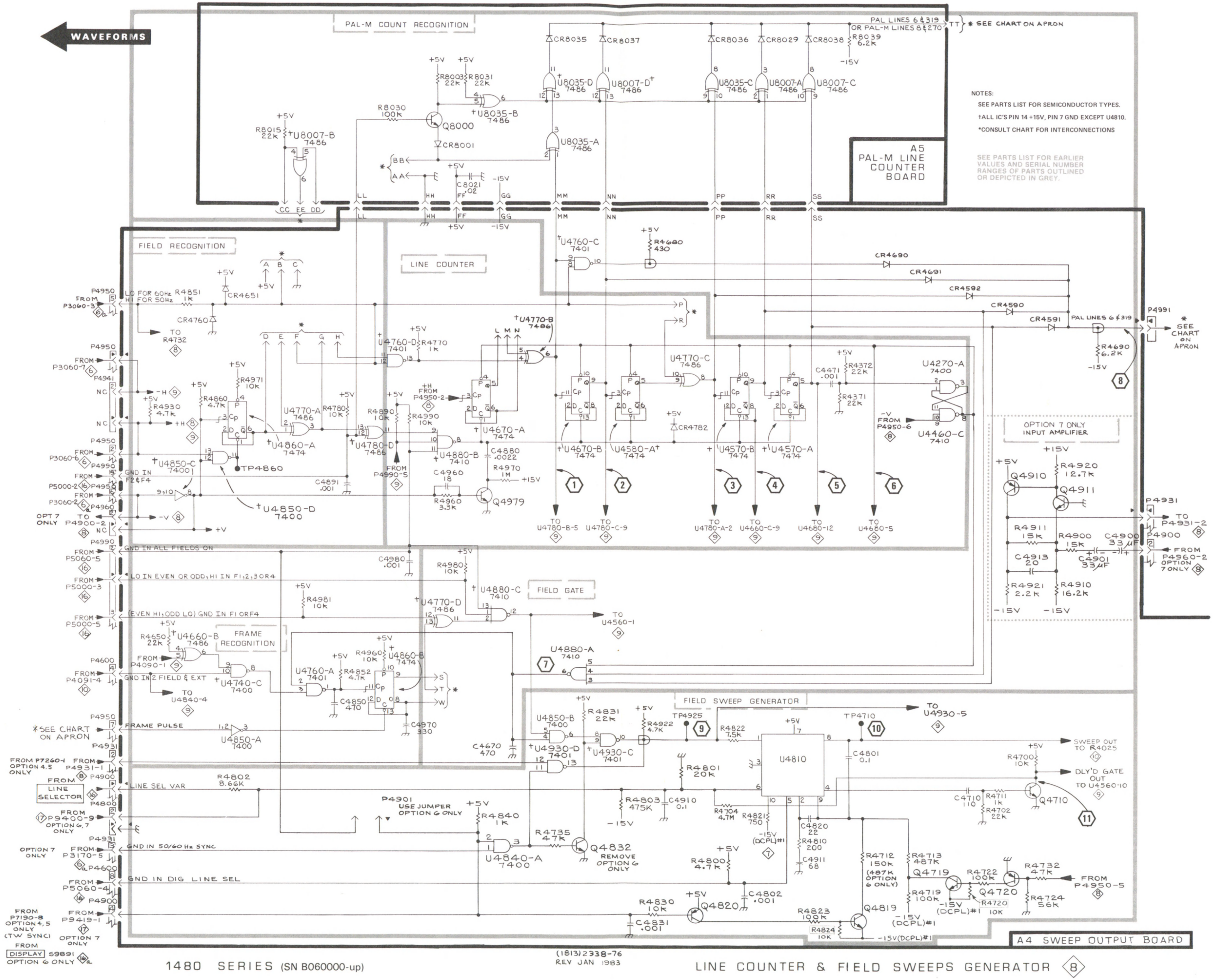
C4900
C4901
C4913

Q4910
Q4911

R4900
R4910
R4911
R4920
R4921

*STANDARDS INTERCONNECTION CHART

STANDARDS SINGLE OR DUAL	P4991-1 TO	P4950-7 FROM	PIN TT TO	THE REMAINING INTERCONNECTIONS FOR THE 2 FIELD GATE GENERATOR SHOULD BE LISTED BELOW:							
NTSC (525/60)	P3080-1	NA	NA	B-C	E-F	G-H	L-M	P-R	T-S		
PAL (625/50)	P3080-1	P3060-1	NA	A-B	E-F	G-H	L-M	P-R	T-S		
PAL-M (525/60)	NA	P3060-1	P3080-1	A-B	C-E	F-H	L-M	P-R	T-EE	S-DD	AA-BB


WAVEFORMS
PAL-M COUNT RECOGNITION
A5 PAL-M LINE COUNTER BOARD
PAL LINES 6 & 319 OR PAL-M LINES 8 & 270
* SEE CHART ON APRON
FIELD RECOGNITION
LINE COUNTER
FRAME RECOGNITION
FIELD GATE
FIELD SWEEP GENERATOR
OPTION 7 ONLY INPUT AMPLIFIER
A4 SWEEP OUTPUT BOARD
U4810
Q8000
Q4979
Q4910
Q4911
Q4710
Q4719
Q4720
Q4819
Q4820
Q4832
TP4860
TP4710
TP4925
P4950
P4991
P4931
P4990
P4900
P4941
P4600
P4801
GND IN ALL FIELDS ON
LO IN EVEN OR ODD; HI IN F1,2,3 OR 4
EVEN HI; ODD LO) GND IN F1 OR F4
GND IN 2 FIELD EXT
FRAME PULSE
LINE SEL VAR
GND IN 50/60 Hz SYNC
GND IN DIG LINE SEL
LO FOR 60Hz HI FOR 50Hz
USE JUMPER OPTION 6 ONLY
REMOVE OPTION 6 ONLY
SWEEP OUT TO R4025
DLY'D GATE OUT TO U4560-10
LINE SELECTOR
DISPLAY
*SEE CHART ON APRON
+5V
-15V
+15V

NOTES:

SEE PARTS LIST FOR SEMICONDUCTOR TYPES.

†ALL IC'S PIN 14 +15V, PIN 7 GND EXCEPT U4810.

*CONSULT CHART FOR INTERCONNECTIONS

SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS OUTLINED OR DEPICTED IN GREY.

1480 SERIES (SN B060000-up)

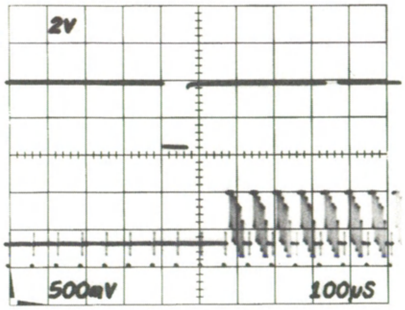
(1813)2338-76
REV JAN 1983

LINE COUNTER & FIELD SWEEPS GENERATOR ⟨8⟩

9

*AC COUPLED

1



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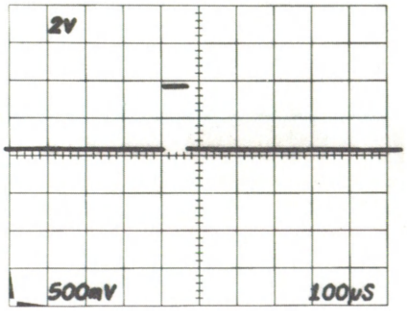

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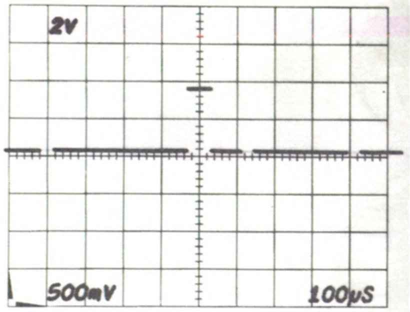

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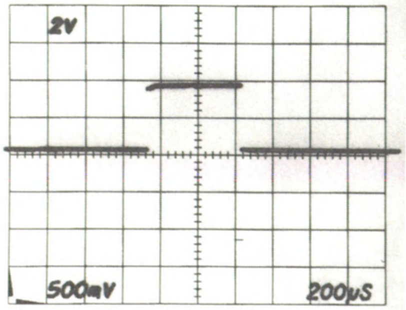

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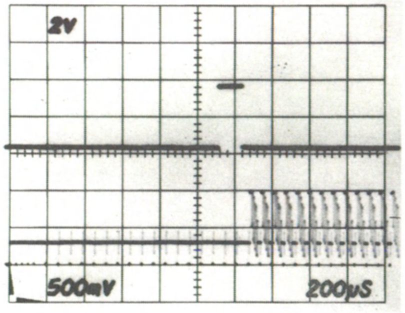

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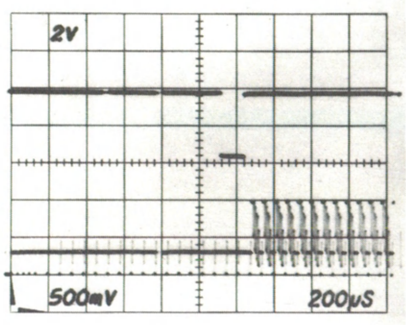

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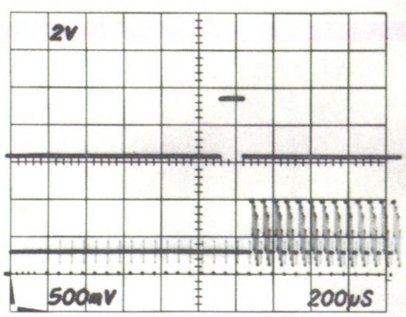

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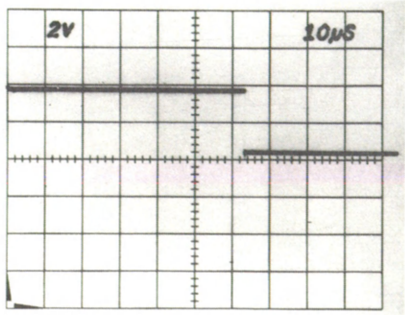

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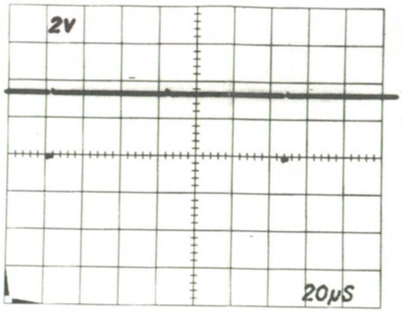

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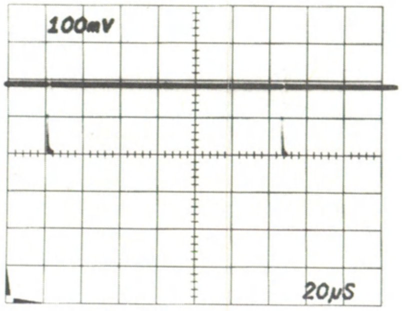
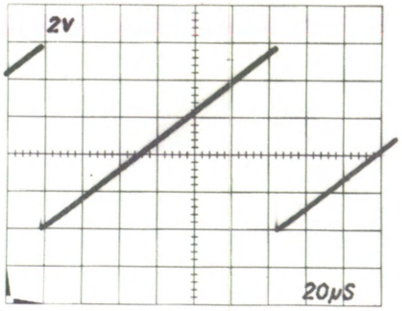


Pulse Tip ≃+ 500mV

11



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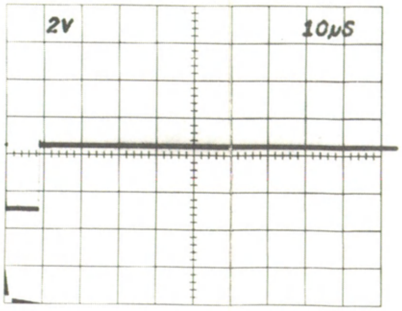


WAVEFORM COMP LOCATE at left of trace

1813-54

⑨

PARTS LOCATING CHART

LINE SELECTOR LOGIC

C4370
C4450
C4460
C4470

C4480
C4481
C4550

C4881
C4892
C4896
C4897

CR4350
CR4370
CR4470

CR4638
CR4640
CR4734

R4370
R4450
R4451
R4460
R4470

R4480
R4481
R4493

R4781
R4880
R4896
R4991

U4460A
U4460B
U4550
U4560A
U4560B
U4560C

U4580B
U4660C
U4680
U4780A
U4780B
U4780C

LINE SWEEP GENERATOR

C4340
C4341
C4440

C4441
C4750
C4751

CR4636
CR4732
CR4733

Q4541

R4340
R4341
R4350
R4351

R4352
R4435
R4440
R4550
R4642

R4731
R4750
R4751
R4850
R4890

TP4250
TP4340
TP4830

U4440
U4640A
U4660A
U4660D

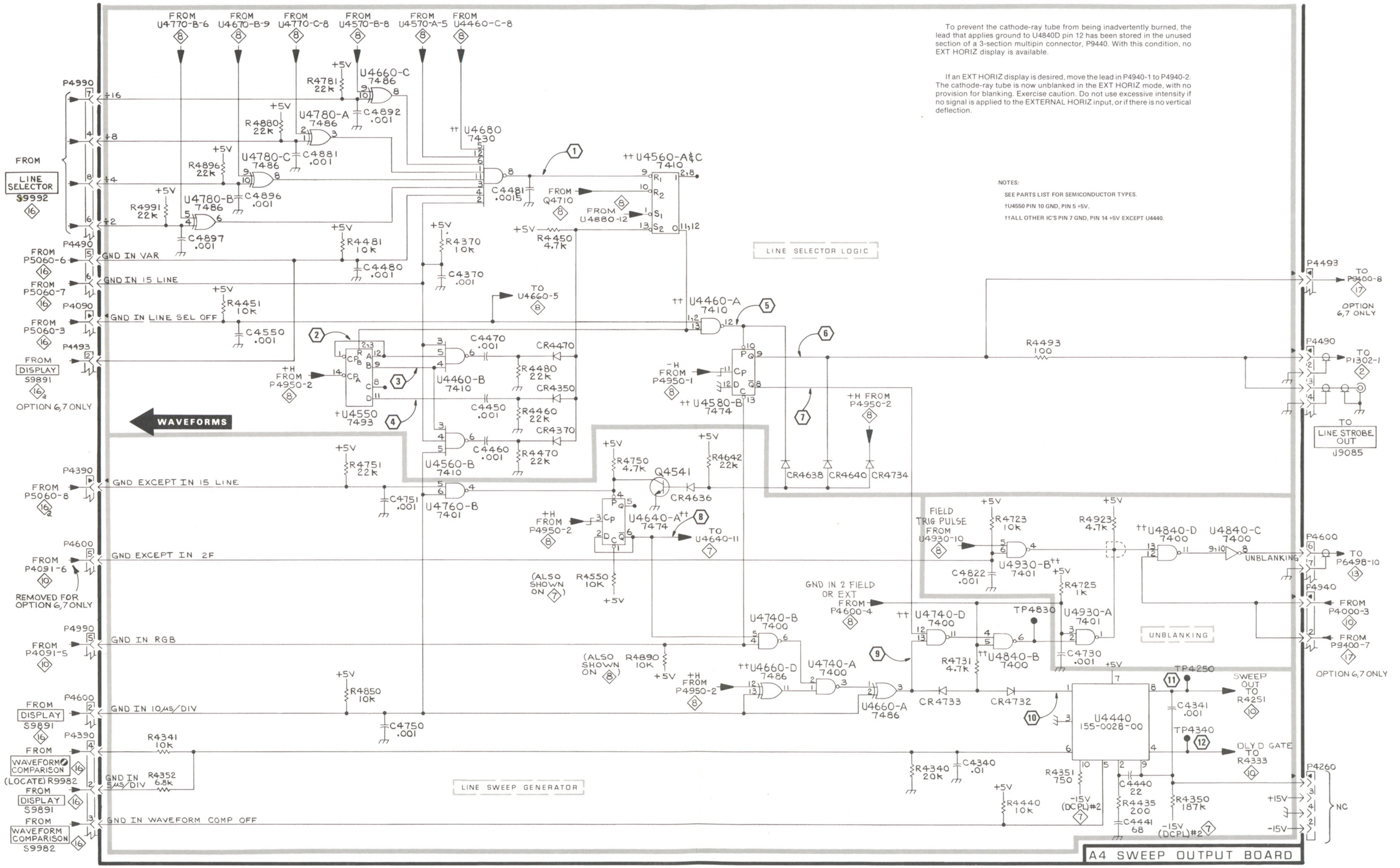
U4740A
U4740B
U4740D
U4760B
U4840B

UNBLANKING

C4730
C4822

R4723
R4725
R4923

U4840C
U4840D
U4930A
U4930B


FROM U4770-B-6 ⑧
FROM U4670-B-9 ⑧
FROM U4770-C-8 ⑧
FROM U4570-B-8 ⑧
FROM U4570-A-5 ⑧
FROM U4460-C-8 ⑧
P4990
FROM LINE SELECTOR S9992 ⑯
FROM P5060-6 ⑯
GND IN VAR
FROM P5060-7 ⑯
GND IN 15 LINE
FROM P5060-3 ⑯
P4090
GND IN LINE SEL OFF
P4493
FROM DISPLAY S9891 ⑯
OPTION 6,7 ONLY
WAVEFORMS
P4390
FROM P5060-8 ⑯
GND EXCEPT IN 15 LINE
P4600
FROM P4091-6 ⑩
GND EXCEPT IN 2F
REMOVED FOR OPTION 6,7 ONLY
FROM P4091-5 ⑩
GND IN RGB
FROM DISPLAY S9891 ⑯
GND IN 10μs/DIV
FROM WAVEFORM COMPARISON (LOCATE) R9982
GND IN 5μs/DIV
FROM DISPLAY S9891
FROM WAVEFORM COMPARISON S9982
GND IN WAVEFORM COMP OFF
U4780-A 7486
U4780-B 7486
U4780-C 7486
U4660-C 7486
U4680 7430
U4560-A&C 7410
U4460-A 7410
U4460-B 7410
U4550 7493
U4560-B 7410
U4760-B 7401
U4580-B 7474
U4640-A 7474
Q4541
U4840-D 7400
U4840-C 7400
U4930-B 7401
U4930-A 7401
U4740-D 7400
U4740-B 7400
U4740-A 7400
U4840-B 7400
U4660-D 7486
U4660-A 7486
U4440 155-0028-00
LINE SELECTOR LOGIC
LINE SWEEP GENERATOR
UNBLANKING
TO P9400-8 ⑰ OPTION 6,7 ONLY
TO P1302-1 ②
TO LINE STROBE OUT J9085
TO P6498-10 ⑬
P4940
FROM P4000-3 ⑩
FROM P9400-7 ⑰
OPTION 6,7 ONLY
SWEEP OUT TO R4251 ⑩
DLY'D GATE TO R4333 ⑩
P4260
NC
A4 SWEEP OUTPUT BOARD

To prevent the cathode-ray tube from being inadvertently burned, the lead that applies ground to U4840D pin 12 has been stored in the unused section of a 3-section multipin connector, P9440. With this condition, no EXT HORIZ display is available.

If an EXT HORIZ display is desired, move the lead in P4940-1 to P4940-2. The cathode-ray tube is now unblanked in the EXT HORIZ mode, with no provision for blanking. Exercise caution. Do not use excessive intensity if no signal is applied to the EXTERNAL HORIZ input, or if there is no vertical deflection.

NOTES:

SEE PARTS LIST FOR SEMICONDUCTOR TYPES.

†U4550 PIN 10 GND, PIN 5 +5V.

††ALL OTHER IC'S PIN 7 GND, PIN 14 +5V EXCEPT U4440.

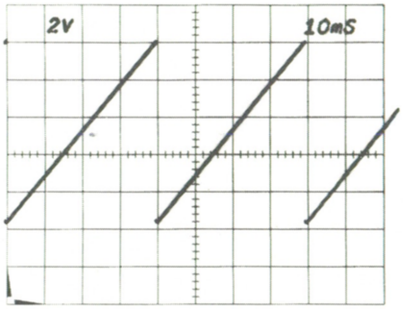
1480 SERIES (SN B060000-up)

(1815) 2338-77
REV B SEP 1980

LINE SELECTOR LOGIC & LINE SWEEP GENERATOR ⑨

10

1



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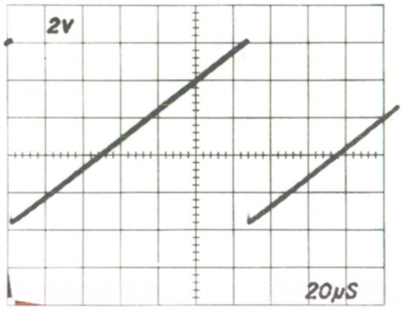

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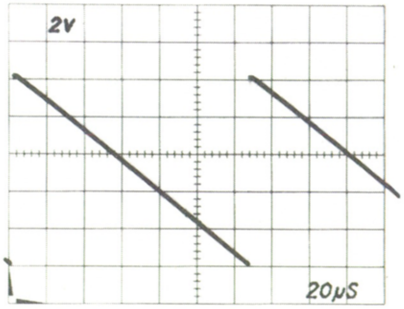


1813-55

⑩

PARTS LOCATING CHART

R G B STEPS INPUT

C4055
C4060

Q4050
Q4051

R4040
R4052
R4060

R4070
R4160
R4161

HORIZONTAL SWITCHING

C4003
C4005
C4022
C4122
C4150

C4151
C4152
C4243
C4250
C4270

CR4024
CR4030
CR4040
CR4130

CR4132
CR4143
CR4150
CR4151

CR4153
CR4154
CR4155
CR4250

Q4020A
Q4020B
Q4115

R4011
R4012
R4013
R4020
R4022

R4025
R4032
R4120
R4123
R4124

R4131
R4133
R4134
R4140
R4146

R4148
R4151
R4153
R4241
R4242

R4250
R4251
R4381
R4382

TP4030
TP4050

U4260A
U4260B
U4260C
U4260D

U4270B
U4270C
U4270D

U4280A
U4280B

HORIZONTAL POSITIONING

C4200
C4201
C4202

Q4211
Q4230
Q4310

R4100
R4125
R4132
R4200

R4201
R4211
R4220
R4333

HORIZONTAL INPUT AMPLIFIER

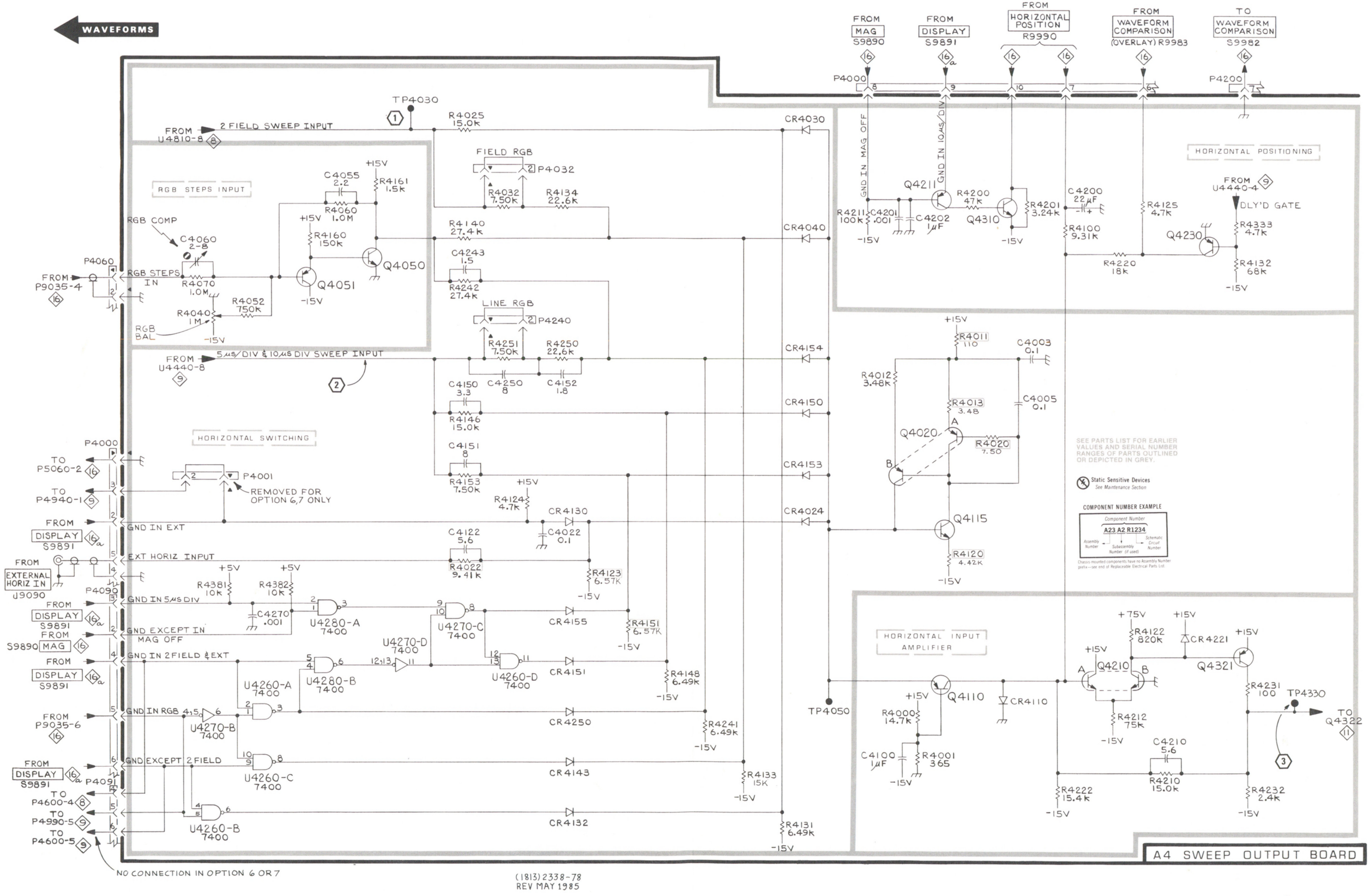
C4100
C4210

CR4110
CR4221

Q4110
Q4210A
Q4210B
Q4321

R4000
R4001
R4122
R4210

R4212
R4222
R4231
R4232



WAVEFORMS
FROM MAG S9890
FROM DISPLAY S9891
FROM HORIZONTAL POSITION R9990
FROM WAVEFORM COMPARISON (OVERLAY) R9983
TO WAVEFORM COMPARISON S9982
P4000
P4200
TP4030
R4025 15.0K
FROM U4810-8
2 FIELD SWEEP INPUT
CR4030
RGB STEPS INPUT
C4055 2.2
+15V
R4161 1.5K
R4060 1.0M
R4160 150K
Q4051
Q4050
RGB COMP
C4060 2-8
RGB STEPS IN
R4070 1.0M
R4052 750K
R4040 1M
RGB BAL
-15V
P4060
FROM P9035-4
FIELD RGB
P4032
R4032 7.50K
R4134 22.6K
R4140 27.4K
C4243 1.5
R4242 27.4K
LINE RGB
P4240
R4251 7.50K
R4250 22.6K
CR4040
CR4154
FROM U4440-8
5μs/DIV & 10μs DIV SWEEP INPUT
C4150 3.3
C4250 8
C4152 1.8
R4146 15.0K
CR4150
C4151 8
R4153 7.50K
CR4153
R4124 4.7K
CR4130
C4022 0.1
CR4024
HORIZONTAL SWITCHING
P4001
REMOVED FOR OPTION 6,7 ONLY
TO P5060-2
TO P4940-1
FROM DISPLAY S9891
GND IN EXT
EXT HORIZ INPUT
FROM EXTERNAL HORIZ IN J9090
C4122 5.6
R4022 9.41K
R4123 6.57K
R4381 10K
R4382 10K
+5V
P4090
GND IN 5μs DIV
C4270 .001
U4280-A 7400
U4270-C 7400
CR4155
R4151 6.57K
GND EXCEPT IN MAG OFF
S9890 MAG
U4270-D 7400
GND IN 2 FIELD & EXT
U4280-B 7400
U4260-D 7400
CR4151
R4148 6.49K
U4260-A 7400
FROM P9035-6
GND IN RGB
U4270-B 7400
CR4250
R4241 6.49K
GND EXCEPT 2 FIELD
U4260-C 7400
CR4143
R4133 15K
P4091
TO P4600-4
TO P4990-5
TO P4600-5
U4260-B 7400
CR4132
R4131 6.49K
NO CONNECTION IN OPTION 6 OR 7
GND IN MAG OFF
GND IN 10μs/DIV
Q4211
R4200 47K
Q4310
R4201 3.24K
C4200 22μF
R4211 100K
C4201 .001
C4202 1μF
R4100 9.31K
R4125 4.7K
HORIZONTAL POSITIONING
FROM U4440-4
DLY'D GATE
Q4230
R4333 4.7K
R4220 18K
R4132 68K
R4011 110
C4003 0.1
R4012 3.48K
R4013 3.48
C4005 0.1
Q4020
A
B
R4020 7.50
Q4115
R4120 4.42K
HORIZONTAL INPUT AMPLIFIER
TP4050
+75V
R4122 820K
CR4221
Q4210
Q4321
Q4110
CR4110
R4000 14.7K
C4100 1μF
R4001 365
R4231 100
TP4330
TO Q4322
R4212 75K
C4210 5.6
R4210 15.0K
R4222 15.4K
R4232 2.4K
A4 SWEEP OUTPUT BOARD

SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS OUTLINED OR DEPICTED IN GREY.

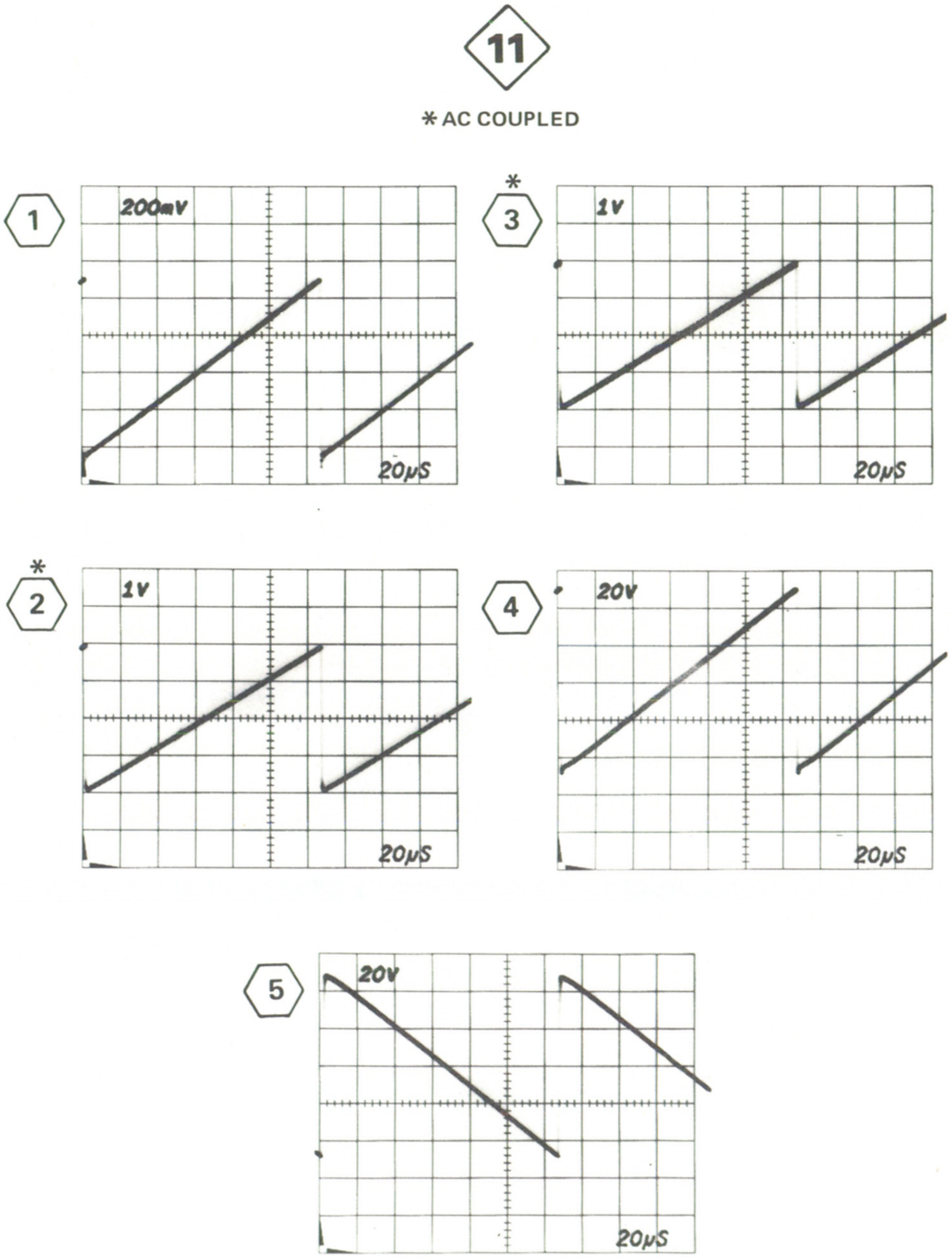
Static Sensitive Devices
See Maintenance Section

COMPONENT NUMBER EXAMPLE

Component Number
A23 A2 R1234
Assembly Number *Subassembly Number (if used)* *Schematic Circuit Number*

Chassis-mounted components have no Assembly Number prefix—see end of Replaceable Electrical Parts List.

(1813) 2338-78
REV MAY 1985


11
* AC COUPLED
1
200mV
20µS
* 3
1V
20µS
* 2
1V
20µS
4
20V
20µS
5
20V
20µS

1813-56

⟨11⟩

PARTS LOCATING CHART

HORIZONTAL MAGNIFIER

C4236

CR4220
CR4421

Q4311
Q4312
Q4313
Q4322

Q4323
Q4410
Q4411

R4221
R4223
R4224
R4233
R4234

R4300
R4301
R4302
R4310
R4311

R4312
R4313
R4314
R4320
R4322

R4323
R4325
R4332
R4400
R4402

R4410
R4411
R4420

TP4330

HORIZONTAL LIMITER

C4431
C4620

CR4424
CR4428

Q4520
Q4521
Q4522
Q4530
Q4531
Q4540

R4240
R4330
R4331
R4422
R4423

R4431
R4432
R4433
R4434
R4522
R4527

R4531
R4532
R4540
R4630
R4631
R4632

TP4420
TP4430

HORIZONTAL DEFLECTION AMPLIFIER

C4410
C4500
C4601

C4611
C4616
C4621

Q4400
Q4500
Q4510
Q4511
Q4600
Q4601

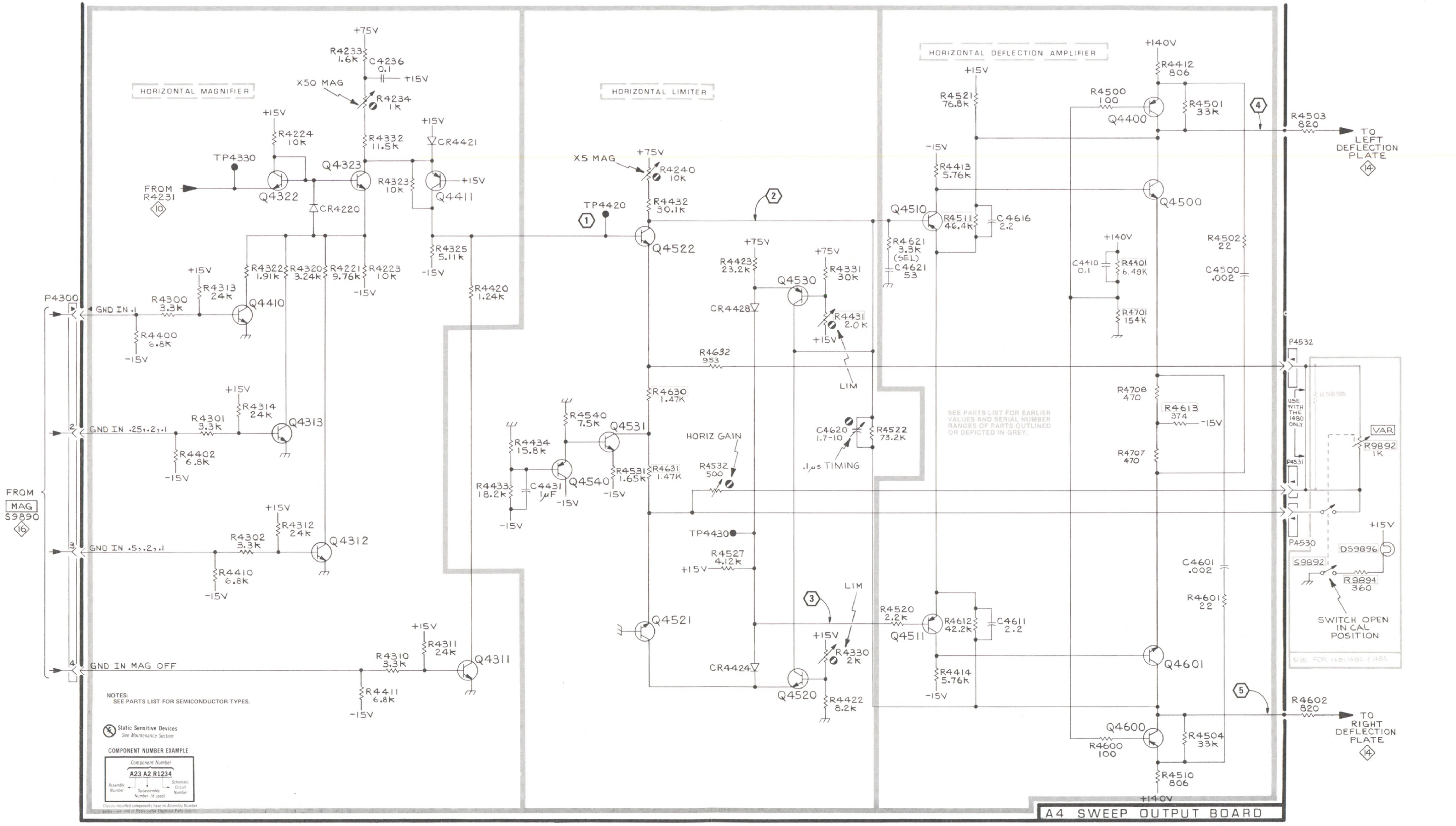
R4401
R4412
R4413
R4414
R4500

R4501
R4502
R4504
R4510
R4511

R4520
R4521
R4600
R4601
R4612

R4613
R4621
R4701
R4707
R4708

WAVEFORMS


HORIZONTAL MAGNIFIER
+75V
R4233 1.6k
C4236 0.1
+15V
X50 MAG
R4234 1k
+15V
R4224 10k
TP4330
Q4323
R4332 11.5k
+15V
CR4421
FROM R4231 ⟨10⟩
Q4322
CR4220
R4323 10k
Q4411
+15V
R4325 5.11k
-15V
R4322 1.91k
R4320 3.24k
R4221 9.76k
R4223 10k
-15V
R4420 1.24k
+15V
R4313 24k
P4300
GND IN .1
R4300 3.3k
Q4410
R4400 6.8k
-15V
+15V
R4314 24k
2
GND IN .25,.2,.1
R4301 3.3k
Q4313
R4402 6.8k
-15V
FROM MAG S9890 ⟨16⟩
+15V
R4312 24k
3
GND IN .5,.2,.1
R4302 3.3k
Q4312
R4410 6.8k
-15V
+15V
R4311 24k
4
GND IN MAG OFF
R4310 3.3k
Q4311
R4411 6.8k
-15V
HORIZONTAL LIMITER
X5 MAG
+75V
R4240 10k
R4432 30.1k
TP4420
①
②
Q4522
+75V
R4423 23.2k
+75V
R4331 30k
Q4530
CR4428
R4431 2.0k
+15V
LIM
R4632 953
R4630 1.47K
R4540 7.5k
Q4531
R4434 15.8k
HORIZ GAIN
C4620 1.7-10
R4522 73.2K
.1μs TIMING
R4531 1.65k
R4631 1.47K
R4532 500
R4433 18.2k
C4431 1μF
Q4540
-15V
-15V
-15V
TP4430
R4527 4.12k
+15V
LIM
③
Q4521
+15V
R4330 2k
CR4424
Q4520
R4422 8.2k
HORIZONTAL DEFLECTION AMPLIFIER
+140V
R4412 806
+15V
R4521 76.8k
R4500 100
Q4400
R4501 33k
④
R4503 820
TO LEFT DEFLECTION PLATE ⟨14⟩
-15V
R4413 5.76k
Q4500
Q4510
R4511 46.4k
C4616 2.2
R4621 3.3k (SEL)
C4621 53
+140V
C4410 0.1
R4401 6.49K
R4701 154K
R4502 22
C4500 .002
SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS OUTLINED OR DEPICTED IN GREY.
R4708 470
R4613 374
-15V
R4707 470
P4532
USE WITH THE 1480 ONLY
R9898
VAR
R9892 1K
P4531
P4530
+15V
DS9896
S9892
R9894 360
SWITCH OPEN IN CAL POSITION
USE FOR 1481, 1482, & 1485
C4601 .002
R4601 22
R4520 2.2k
Q4511
R4612 42.2k
C4611 2.2
R4414 5.76k
-15V
Q4601
⑤
R4602 820
TO RIGHT DEFLECTION PLATE ⟨14⟩
Q4600
R4600 100
R4504 33k
R4510 806
+140V
A4 SWEEP OUTPUT BOARD

NOTES:
SEE PARTS LIST FOR SEMICONDUCTOR TYPES.

Static Sensitive Devices
See Maintenance Section

COMPONENT NUMBER EXAMPLE

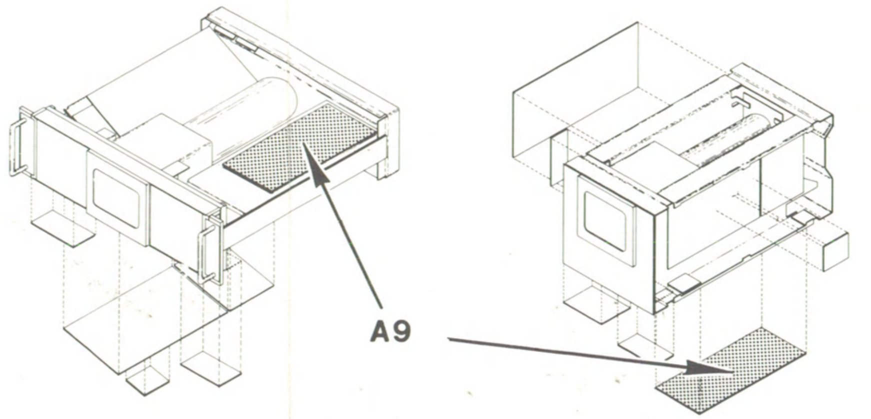
Component Number
A23 A2 R1234
Assembly Number — Subassembly Number (if used) — Schematic Circuit Number

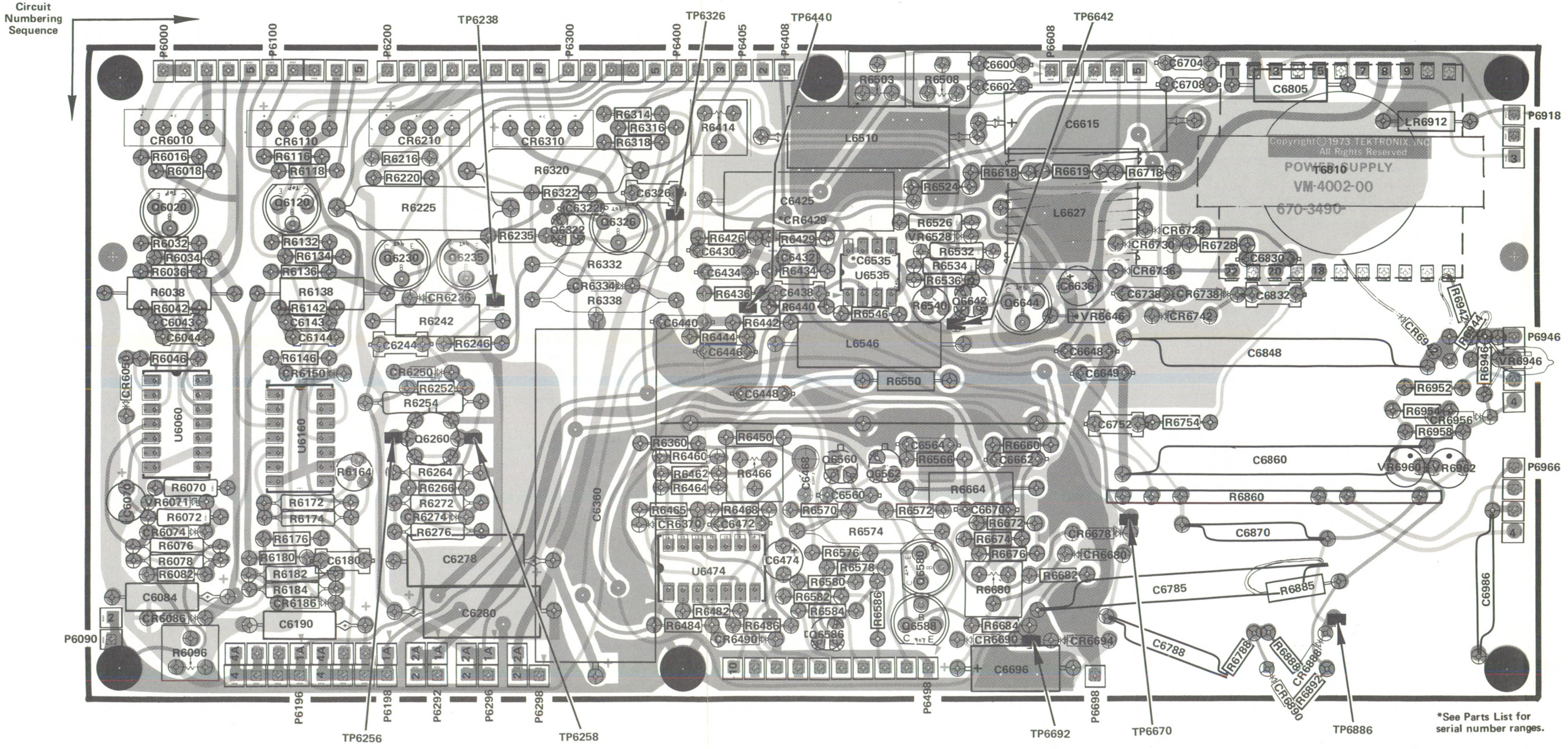
Chassis-mounted components have no Assembly Number prefix—see end of Replaceable Electrical Parts List.

REV MAY 1985
(1813) 2338-79

1480 SERIES (SN B060000-up)

HORIZONTAL AMPLIFIER ⟨11⟩




Circuit Numbering Sequence
P6000
P6100
P6200
TP6238
P6300
P6400
TP6326
P6405
P6408
TP6440
P6608
TP6642
P6918
P6946
P6966
P6090
P6196
P6198
P6292
P6296
P6298
P6498
P6698
TP6256
TP6258
TP6692
TP6670
TP6886
CR6010
CR6110
CR6210
CR6310
R6016
R6018
R6116
R6118
R6216
R6220
R6314
R6316
R6318
R6414
R6320
R6225
Q6020
Q6120
Q6230
Q6235
Q6326
R6032
R6034
R6036
R6132
R6134
R6136
R6038
R6138
R6042
C6043
C6044
R6142
C6143
C6144
R6242
C6244
R6246
R6046
R6146
R6150
U6060
U6160
R6250
R6252
R6254
Q6260
R6164
R6264
R6266
R6272
C6274
R6276
R6070
VR6071
R6072
C6070
R6172
R6174
C6074
R6076
R6078
R6082
R6176
R6180
R6182
C6180
R6184
CR6186
C6084
CR6086
C6190
R6096
C6278
C6280
C6360
R6332
CR6334
R6338
C6440
R6444
C6446
C6448
R6426
C6430
C6434
R6436
R6429
C6432
R6434
C6438
R6440
R6442
C6425
CR6429
L6510
L6546
R6550
R6503
R6508
C6600
C6602
C6615
R6524
R6526
VR6528
R6532
R6534
R6536
Q6542
R6540
C6535
U6535
R6546
Q6644
C6636
VR6646
C6648
C6649
R6618
R6619
R6718
L6627
CR6728
R6728
CR6730
CR6736
C6738
CR6738
CR6742
C6704
C6708
C6805
LR6912
T6810
POWER SUPPLY
VM-4002-00
670-3490
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C6830
C6832
C6848
R6942
R6944
VR6946
R6952
R6954
CR6956
R6958
VR6960
VR6962
C6860
R6860
C6870
C6752
R6754
R6360
R6460
R6462
R6464
R6450
R6466
R6465
R6468
CR6370
C6472
U6474
R6484
R6482
R6486
C6490
Q6560
Q6562
C6560
C6564
R6566
R6570
R6572
R6574
C6474
R6576
R6578
R6580
R6582
R6584
R6586
CR6586
Q6588
R6664
C6660
C6662
C6670
C6672
R6674
R6676
R6680
R6684
CR6690
C6696
CR6694
R6692
CR6678
CR6680
C6785
R6885
C6788
R6786
R6888
CR6888
R6892
CR6890
C6986
TOP
BOTTOM

*See Parts List for serial number ranges.

A9 POWER SUPPLY BOARD

REV A SEP 1980

TOP **BOTTOM**

⑫

PARTS LOCATING CHART

+140 V SUPPLY

C6278
C6322
C6326
C6360

CR6310
CR6334

Q6322
Q6326

R6235
R6314
R6316
R6318

R6320
R6322
R6332
R6338

TP6326

+75 V SUPPLY

C6244
C6280

CR6210
CR6236
CR6250
CR6274

Q6230
Q6235
Q6260A
Q6260B

R6216
R6220
R6225
R6242
R6246

R6252
R6254
R6264
R6266
R6272
R6276

TP6256
TP6258
TP6328

+15 V SUPPLY

C6143
C6144
C6180
C6190

CR6110
CR6150
CR6186

Q6120

R6116
R6118
R6132
R6134
R6136

R6138
R6142
R6146
R6164
R6172

R6174
R6176
R6180
R6182
R6184

U6160

−15 V SUPPLY

C6043
C6044
C6070
C6084

CR6010
CR6050
CR6074
CR6086

Q6020

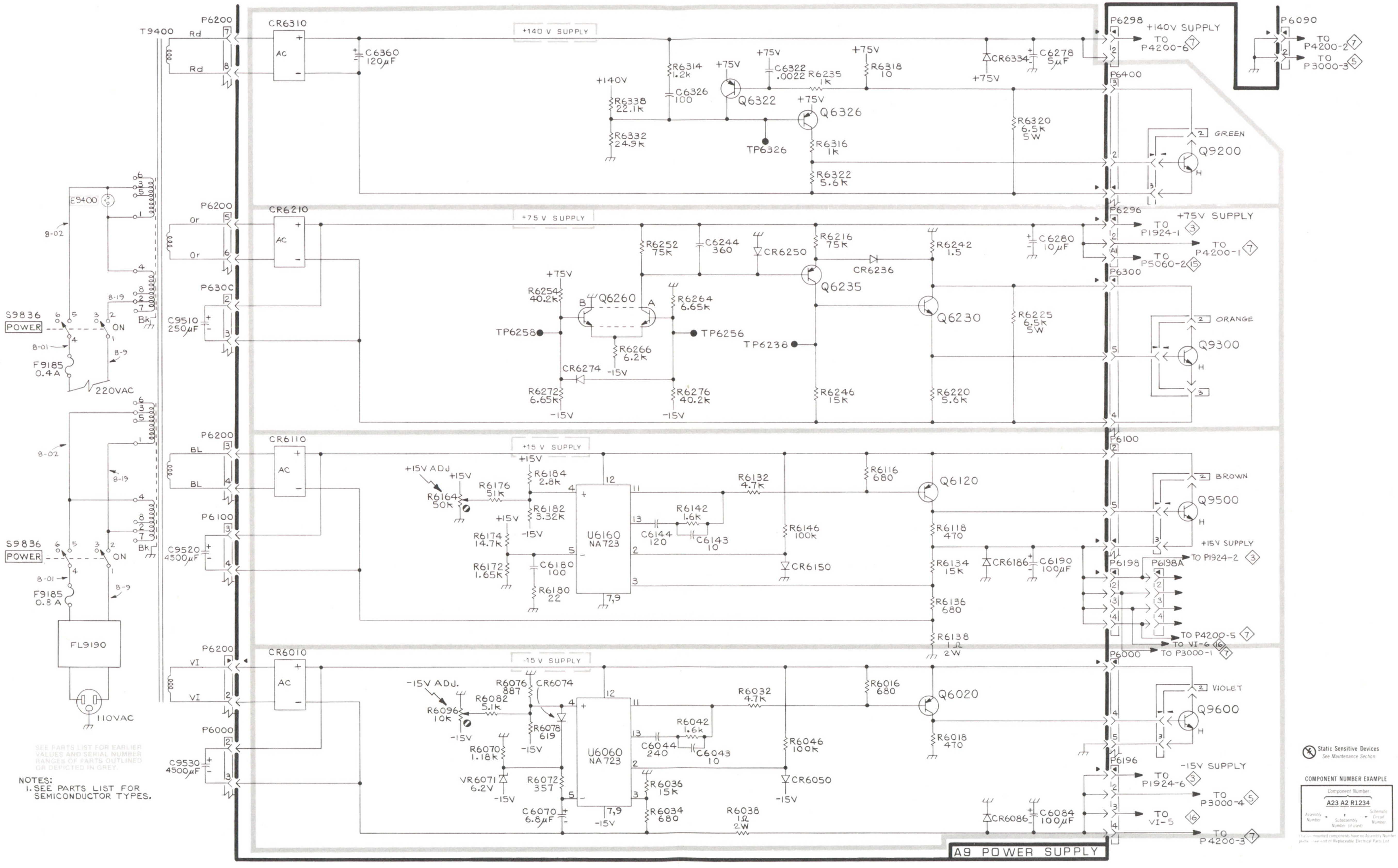
R6016
R6018
R6032
R6034
R6036

R6038
R6042
R6046
R6070
R6072

R6076
R6078
R6082
R6096

U6060

VR6071


T9400
P6200
Rd
CR6310
AC
C6360 120µF
+140 V SUPPLY
+140V
R6338 22.1K
R6332 24.9K
R6314 1.2K
C6326 100
+75V
Q6322
C6322 .0022
R6235 1K
Q6326
TP6326
R6316 1K
R6322 5.6K
R6318 10
CR6334
C6278 5µF
R6320 6.5K 5W
P6298
+140V SUPPLY
TO P4200-6 ⑦
P6090
TO P4200-2 ⑦
TO P3000-3 ⑤
P6400
GREEN
Q9200
E9400
8-02
Or
P6300
C9510 250µF
S9836 POWER
ON
Bk
8-01
8-9
8-19
F9185 0.4A
220VAC
CR6210
+75 V SUPPLY
R6252 75K
C6244 360
CR6250
R6216 75K
CR6236
R6242 1.5
C6280 10µF
P6296
+75V SUPPLY
TO P1924-1 ③
TO P4200-1 ⑦
TO P5060-2 ⑮
R6254 40.2K
Q6260
TP6258
R6264 6.65K
TP6256
TP6236
Q6235
Q6230
R6225 6.5K 5W
ORANGE
Q9300
R6266 6.2K
CR6274
R6272 6.65K
R6276 40.2K
R6246 15K
R6220 5.6K
-15V
BL
P6100
CR6110
+15 V SUPPLY
+15V ADJ
R6164 50K
R6176 51K
R6184 2.8K
R6182 3.32K
R6174 14.7K
R6172 1.65K
C6180 100
R6180 22
U6160 NA723
C6144 120
R6142 1.6K
C6143 10
R6132 4.7K
R6146 100K
CR6150
R6116 680
Q6120
R6118 470
R6134 15K
CR6186
C6190 100µF
R6136 680
R6138 1Ω 2W
C9520 4500µF
F9185 0.8A
FL9190
110VAC
P6198
P6198A
BROWN
Q9500
+15V SUPPLY
TO P1924-2 ③
TO P4200-5 ⑦
TO VI-6 ⑯
TO P3000-1 ⑤
VI
P6000
CR6010
-15 V SUPPLY
-15V ADJ.
R6096 10K
R6076 887
R6082 5.1K
CR6074
R6078 619
R6070 1.18K
VR6071 6.2V
R6072 357
C6070 6.8µF
U6060 NA723
R6042 1.6K
C6044 240
C6043 10
R6036 15K
R6034 680
R6032 4.7K
R6038 1Ω 2W
R6046 100K
CR6050
R6016 680
Q6020
R6018 470
CR6086
C6084 100µF
C9530 4500µF
VIOLET
Q9600
P6196
-15V SUPPLY
TO P1924-6 ③
TO P3000-4 ⑤
TO VI-5 ⑯
TO P4200-3 ⑦
A9 POWER SUPPLY

SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS OUTLINED OR DEPICTED IN GREY.

NOTES:
1. SEE PARTS LIST FOR SEMICONDUCTOR TYPES.

Static Sensitive Devices
See Maintenance Section

COMPONENT NUMBER EXAMPLE

Component Number
A23 A2 R1234
Assembly Number · *Subassembly Number (if used)* · *Schematic Circuit Number*

Chassis mounted components have no Assembly Number prefix—see end of Replaceable Electrical Parts List

1480 SERIES (SN B060000-up)

(1813) 2338-80
REV FEB 1982

LOW VOLTAGE POWER SUPPLY ⑫

13

PARTS LOCATING CHART

Z AXIS LOGIC

C6440
C6448
C6472
C6474

CR6370
CR6490

Q6586

R6442
R6460
R6462

R6464
R6465
R6466
R6468

R6482
R6484
R6486
R6488*
R6550

R6578
R6580
R6582
R6584
R6586

U6474A
U6474B
U6474C
U6474D
U6474E

Z AXIS AMPLIFIER

C6446
C6468
C6560
C6564
C6662
C6670

CR6694

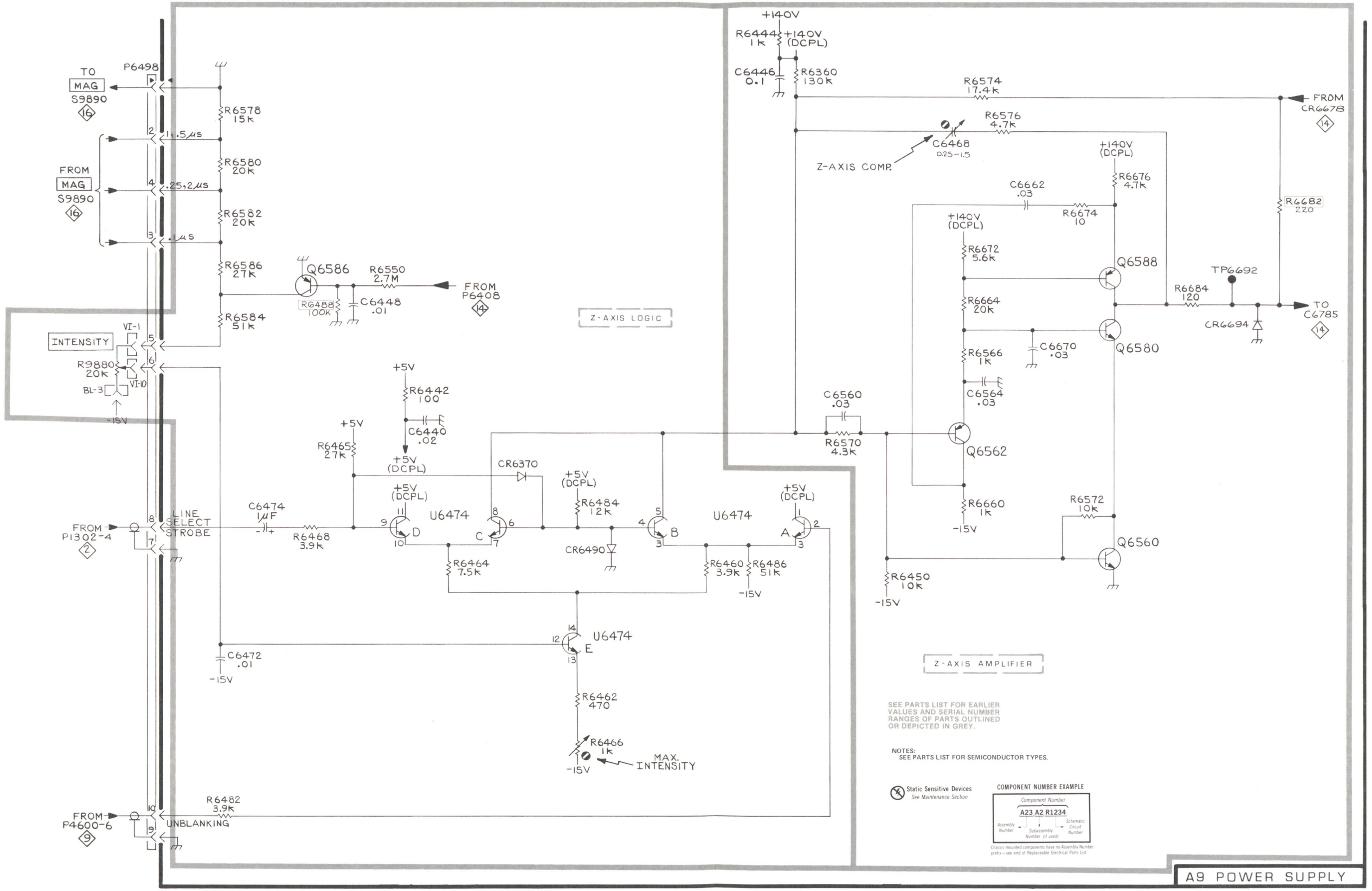
Q6560
Q6562
Q6580
Q6588

R6360
R6444
R6450
R6566
R6570

R6572
R6574
R6576
R6660

R6664
R6672
R6674
R6676
R6682
R6684

TP6692


TO
MAG
S9890
16
P6498
FROM
MAG
S9890
16
2
1,.5μs
4
.25,2μs
3
.1μs
R6578
15k
R6580
20k
R6582
20k
R6586
27k
R6584
51k
Q6586
R6488
100k
C6448
.01
R6550
2.7M
FROM
P6408
14
INTENSITY
VI-1
5
6
R9880
20k
VI-10
BL-3
-15V
Z-AXIS LOGIC
+5V
R6442
100
C6440
.02
+5V
R6465
27k
+5V
(DCPL)
CR6370
FROM
P1302-4
2
8
7
LINE
SELECT
STROBE
C6474
1μF
R6468
3.9k
+5V
(DCPL)
11
9
10
D
U6474
8
C
6
7
R6464
7.5k
+5V
(DCPL)
R6484
12k
CR6490
4
5
B
3
U6474
+5V
(DCPL)
1
A
2
3
R6460
3.9k
R6486
51k
-15V
14
12
U6474
E
13
C6472
.01
-15V
R6462
470
R6466
1k
-15V
MAX.
INTENSITY
FROM
P4600-6
9
10
9
R6482
3.9k
UNBLANKING
+140V
R6444
1k
+140V
(DCPL)
C6446
0.1
R6360
130k
R6574
17.4k
FROM
CR6678
14
R6576
4.7k
C6468
0.25-1.5
Z-AXIS COMP.
+140V
(DCPL)
R6676
4.7k
C6662
.03
R6674
10
R6682
220
+140V
(DCPL)
R6672
5.6k
Q6588
R6684
120
TP6692
TO
C6785
14
CR6694
R6664
20k
Q6580
R6566
1k
C6670
.03
C6564
.03
C6560
.03
R6570
4.3k
Q6562
R6660
1k
-15V
R6572
10k
Q6560
R6450
10k
-15V
Z-AXIS AMPLIFIER
Static Sensitive Devices
See Maintenance Section
COMPONENT NUMBER EXAMPLE
Component Number
A23 A2 R1234
Assembly Number
Subassembly Number (if used)
Schematic Circuit Number
A9 POWER SUPPLY

SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS OUTLINED OR DEPICTED IN GREY.

NOTES:
SEE PARTS LIST FOR SEMICONDUCTOR TYPES.

Chassis-mounted components have no Assembly Number prefix—see end of Replaceable Electrical Parts List.

14

PARTS LOCATING CHART

H V REGULATOR

- C6425
- C6430
- C6432
- C6434
- C6435
- C6538

- C6615
- C6636
- C6648
- C6649

- C6830
- C6848
- C6860
- C6870

- CR6429
- CR6728
- CR6730
- CR6736
- CR6942

- L6510
- L6546
- L6627

- Q6642
- Q6644

- R6426
- R6429
- R6434
- R6436
- R6440

- R6524
- R6526
- R6532
- R6534
- R6536

- R6540
- R6546
- R6728
- R6860A
- R6860B

- R6942
- R6944
- R6946
- R6947

- T6810

- TP6440
- TP6642

- U6535

- VR6528
- VR6946

H V OSCILLATOR

- C6805

- LR6912

CHASSIS

- L9350
- L9650

- Q9180

- R9882
- R9935

- U9240

- V9600

CRT BIASING

- C6600
- C6602
- C6696
- C6704
- C6708

- C6738
- C6752
- C6785
- C6788
- C6832
- C6986

- CR6678
- CR6680
- CR6690
- CR6694

- CR6738
- CR6742
- CR6888
- CR6890
- CR6956

- R6414
- R6503
- R6508
- R6618
- R6619

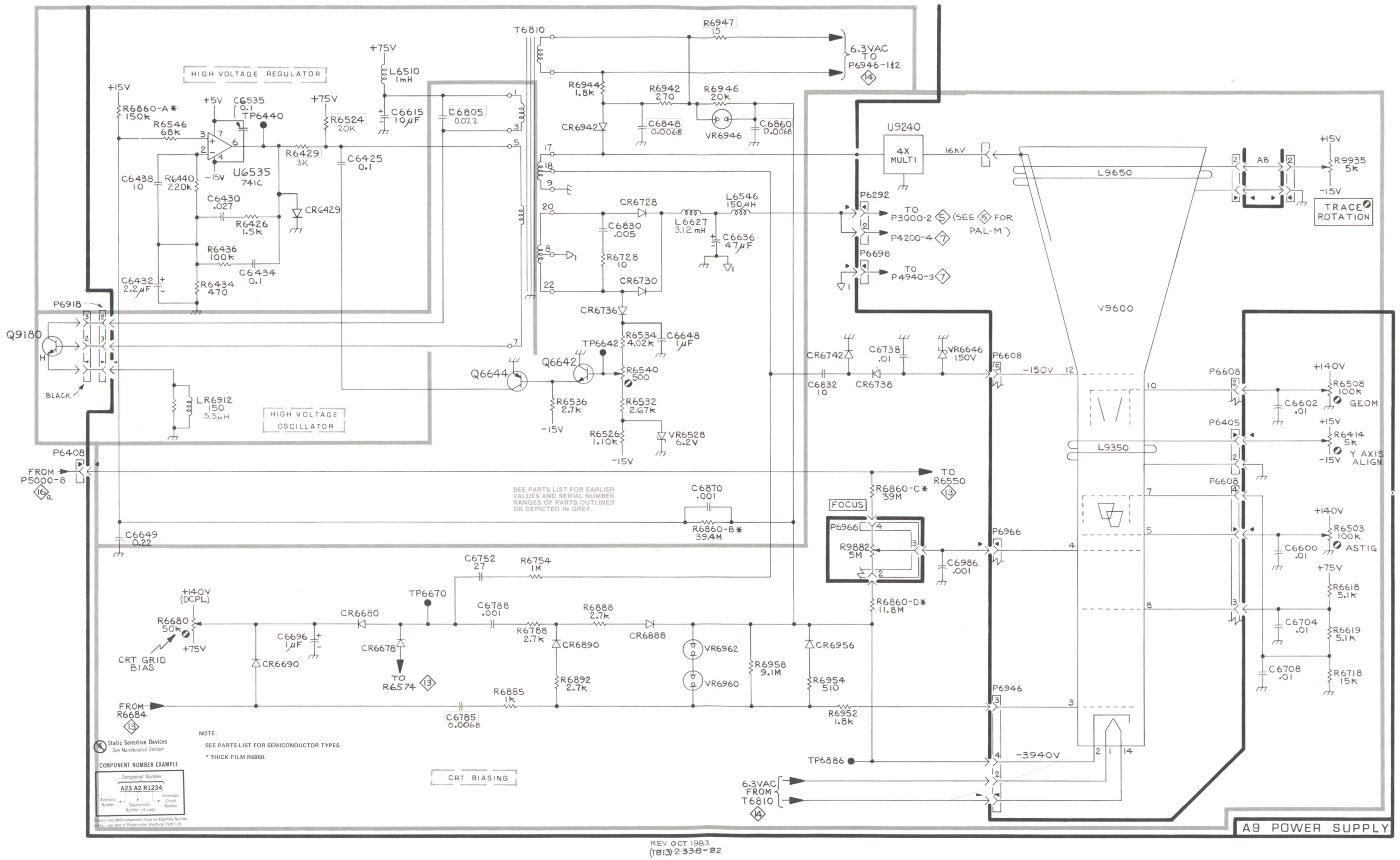
- R6680
- R6682
- R6718
- R6754
- R6788

- R6860C
- R6860D
- R6885
- R6888
- R6892

- R6952
- R6954
- R6958

- TP6670
- TP6692
- TP6886

- VR6646
- VR6960
- VR6962


HIGH VOLTAGE REGULATOR
HIGH VOLTAGE OSCILLATOR
CRT BIASING
A9 POWER SUPPLY
+15V
R6860-A✱ 150k
R6546 68k
+5V
C6535 0.1
TP6440
U6535 741C
-15V
+75V
R6524 20K
R6429 3K
C6425 0.1
L6510 1mH
C6615 10µF
C6805 0.022
C6438 10
R6440 220k
C6430 .027
R6426 1.5k
CR6429
R6436 100k
C6434 0.1
C6432 2.2µF
R6434 470
P6918
Q9180
H
BLACK
LR6912 150 5.5µH
P6408
FROM P5000-8 16a
T6810
R6947 15
6.3VAC TO P6946-1&2 14
R6944 1.8k
R6942 270
R6946 20k
CR6942
C6848 0.0068
VR6946
C6860 0.0068
CR6728
C6830 .005
R6728 10
CR6730
L6627 3.12 mH
L6546 150µH
C6636 47µF
CR6736
R6534 4.02k
C6648 1µF
TP6642
Q6642
Q6644
R6540 500
R6536 2.7k
R6532 2.67k
R6526 1.10k
VR6528 6.2V
U9240
4X MULTI
16kV
L9650
A8
R9935 5k
TRACE ROTATION
P6292
TO P3000-2 5 (SEE 5 FOR PAL-M)
P4200-4 7
P6698
TO P4940-3 7
V9600
CR6742
C6738 .01
VR6646 150V
C6832 10
CR6738
P6608
-150V
P6608
+140V
R6508 100k
C6602 .01
GEOM
P6405
R6414 5k
Y AXIS ALIGN
L9350
TO R6550 13
C6870 .001
R6860-B✱ 39.4M
R6860-C✱ 39M
FOCUS
P6966
R9882 5M
C6986 .001
R6860-D✱ 11.8M
R6503 100k
ASTIG
C6600 .01
R6618 5.1k
C6704 .01
R6619 5.1k
C6708 .01
R6718 15k
C6649 0.22
C6752 27
R6754 1M
+140V (DCPL)
R6680 50k
CRT GRID BIAS
CR6690
C6696 1µF
CR6680
CR6678
TO R6574 13
TP6670
C6788 .001
R6788 2.7k
CR6890
R6888 2.7k
CR6888
R6892 2.7k
R6885 1k
C6785 0.0068
VR6962
VR6960
R6958 9.1M
CR6956
R6954 510
R6952 1.8k
FROM R6684 13
P6946
TP6886
-3940V
6.3VAC FROM T6810 14

SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS OUTLINED OR DEPICTED IN GREY.

Static Sensitive Devices
See Maintenance Section

COMPONENT NUMBER EXAMPLE

Component Number
A23 A2 R1234
Assembly Number — *Subassembly Number (if used)* — *Schematic Circuit Number*

Chassis mounted components have no Assembly Number prefix—see end of Replaceable Electrical Parts List

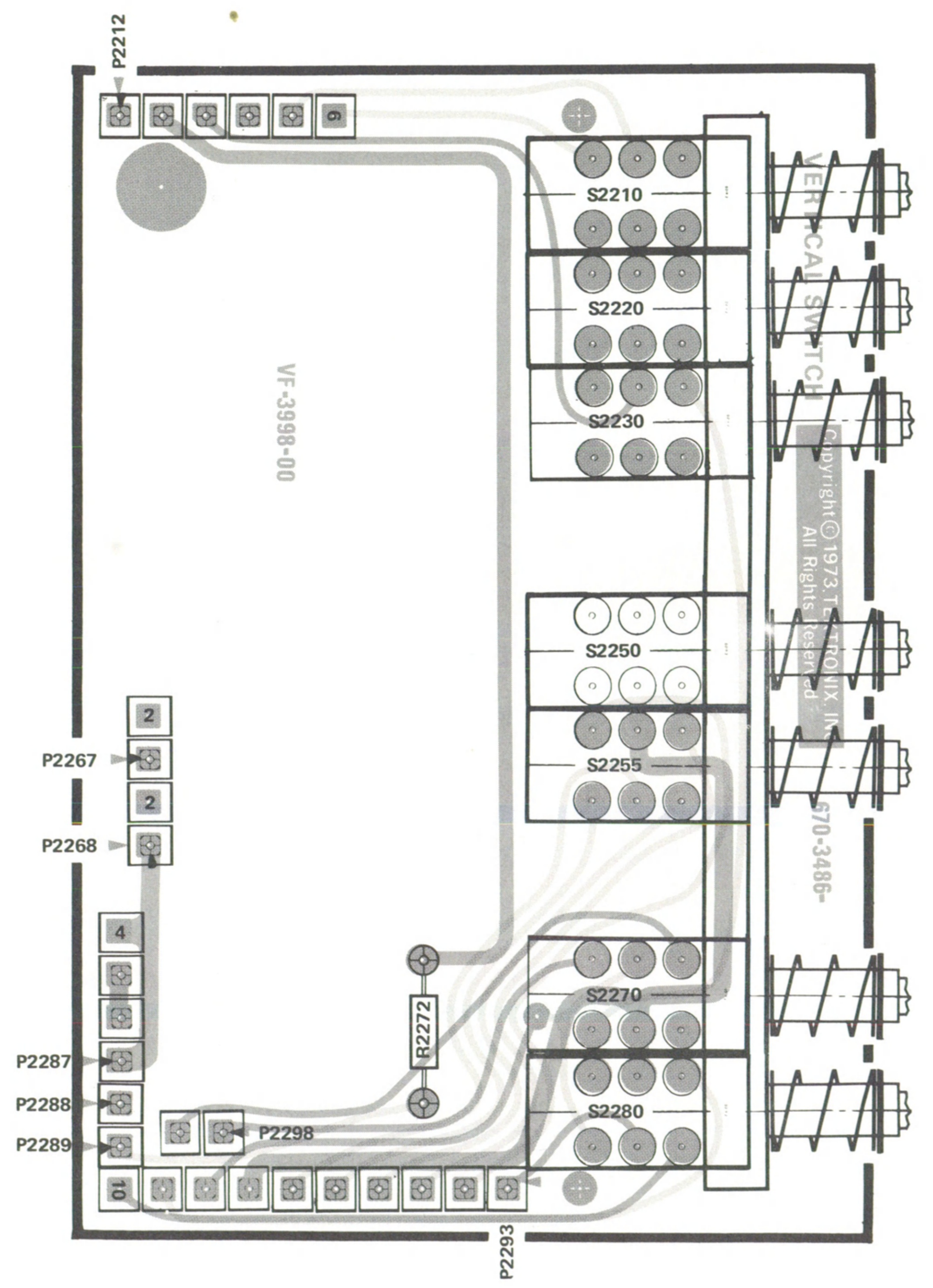
NOTE:

SEE PARTS LIST FOR SEMICONDUCTOR TYPES.

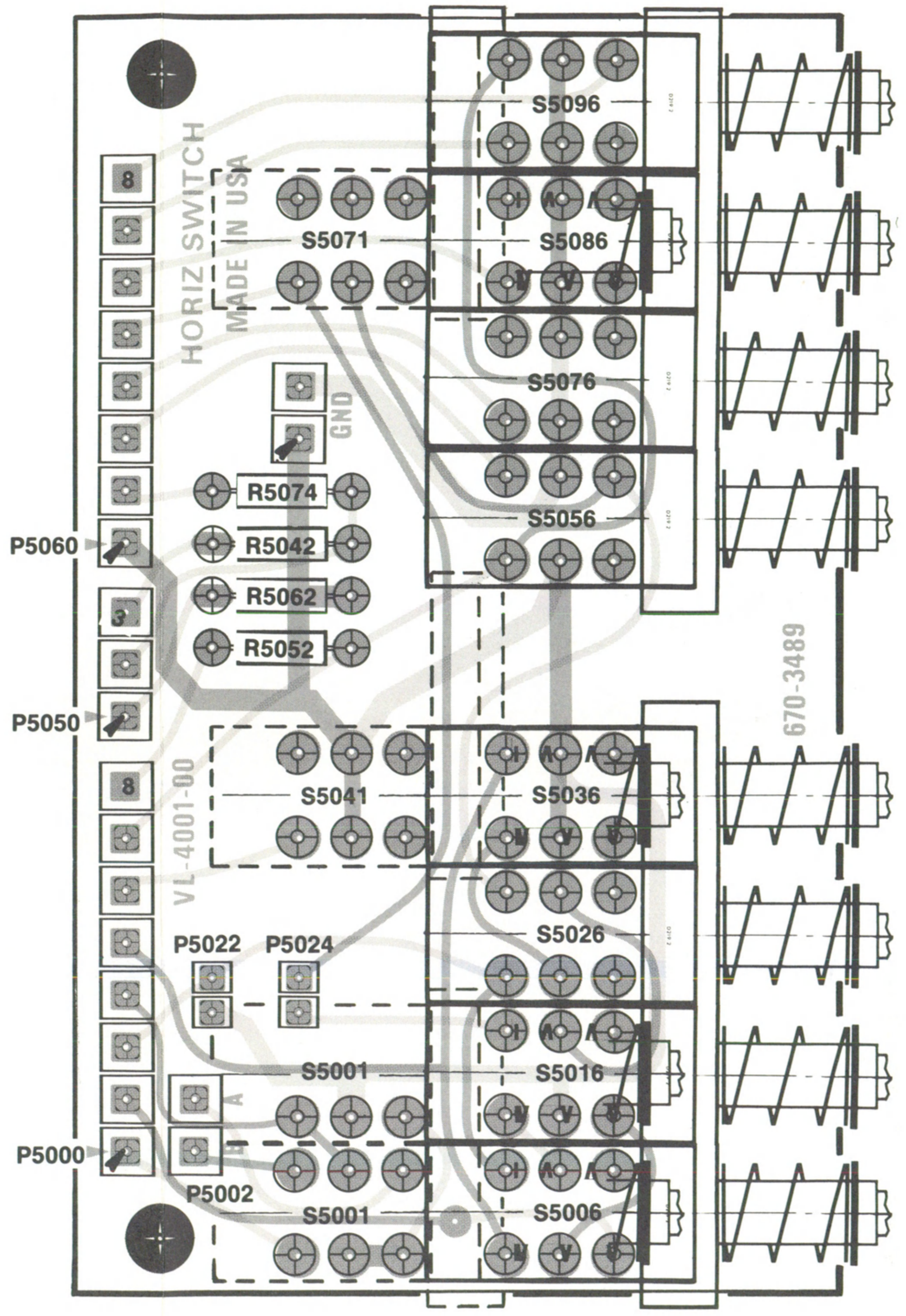
* THICK FILM R6860.

REV OCT 1983
(1813) 2338-82

HIGH VOLTAGE POWER SUPPLY 14

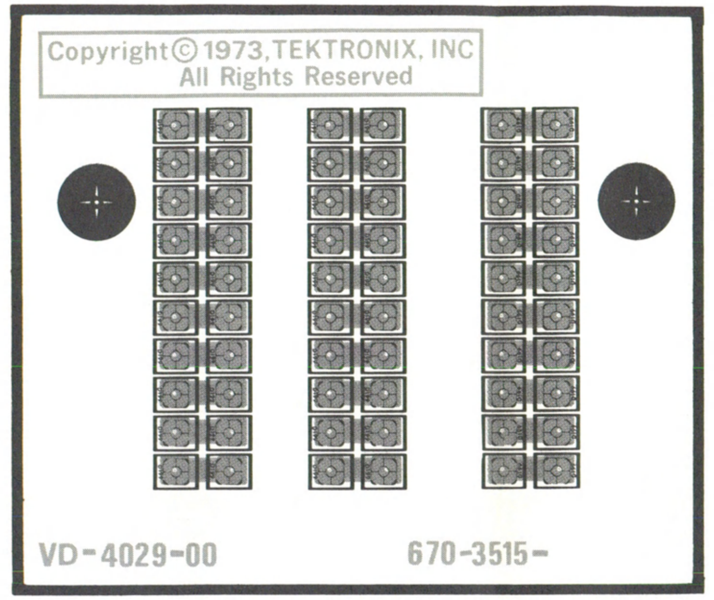

P2212
6
S2210
S2220
S2230
VER CAL SWITCH
VF-3998-00
Copyright © 1973 TEKTRONIX INC All Rights Reserved
S2250
S2255
2
P2267
2
P2268
670-3486-
4
P2287
P2288
P2289
P2298
R2272
S2270
S2280
10
P2293

A1 VERTICAL SWITCH BOARD

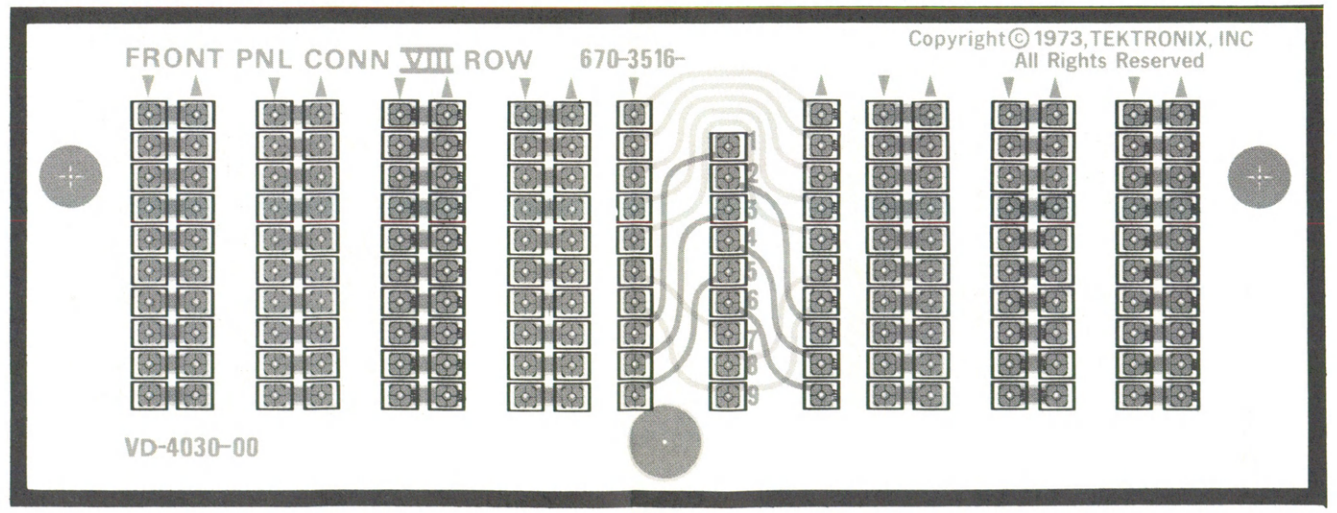

HORIZ SWITCH
MADE IN USA
8
S5096
S5071
S5086
S5076
GND
R5074
R5042
R5062
R5052
S5056
P5060
3
P5050
670-3489
8
S5041
S5036
VL-4001-00
S5026
P5022
P5024
S5001
S5016
P5000
P5002
S5001
S5006

A3 HORIZONTAL SWITCH BOARD

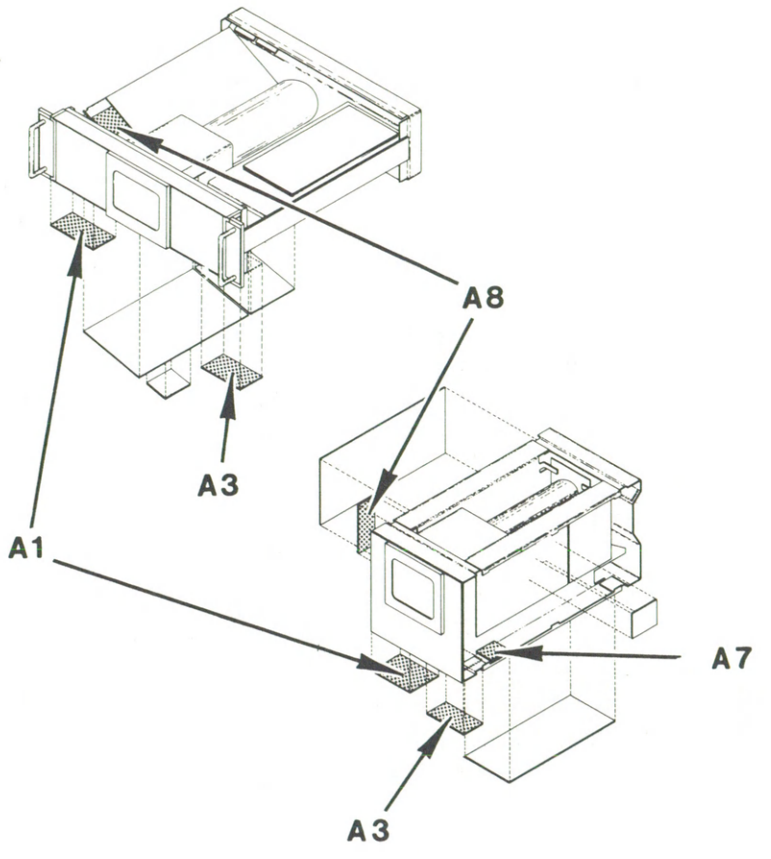
TOP BOTTOM


Copyright © 1973, TEKTRONIX, INC
All Rights Reserved
VD-4029-00
670-3515-

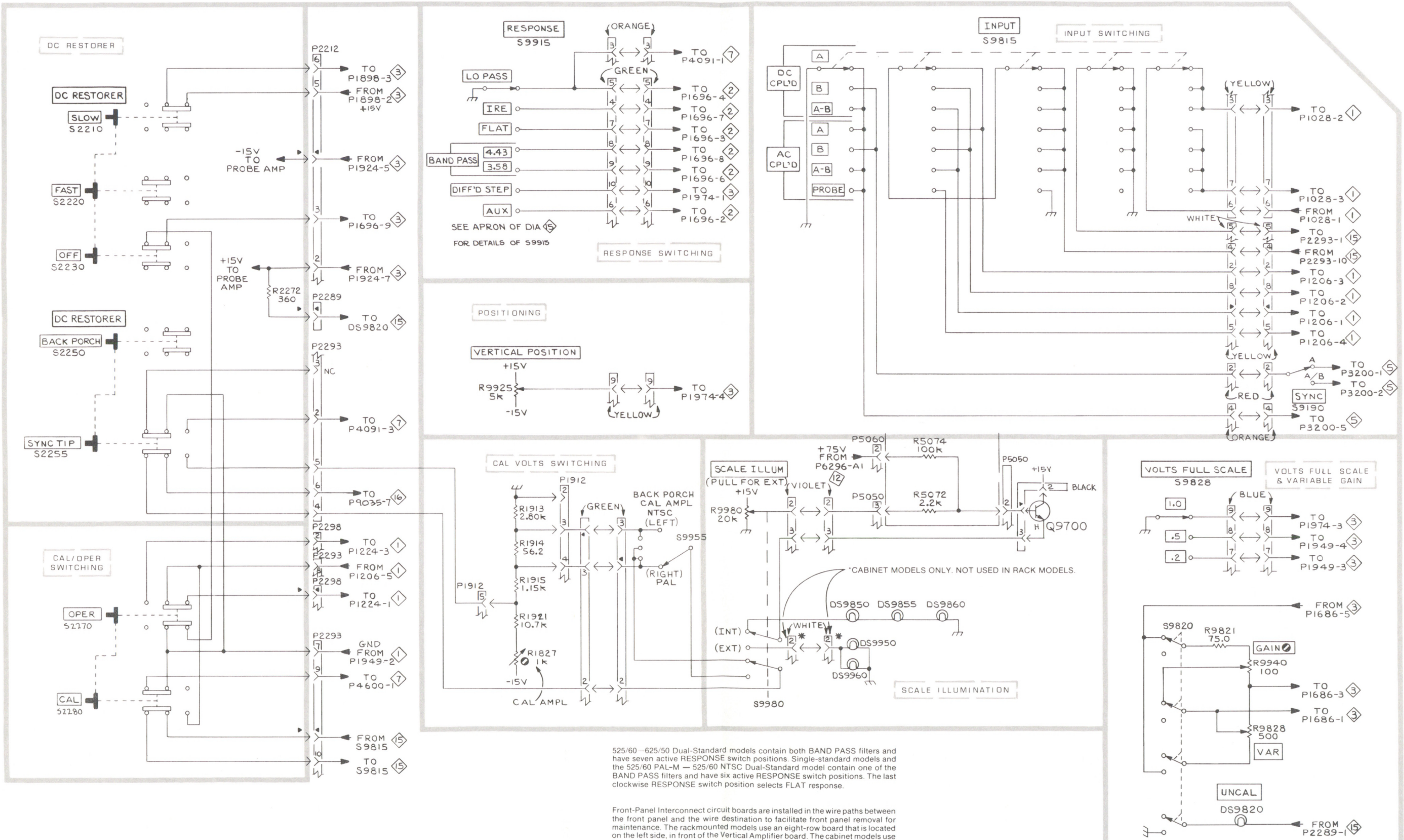
A7 FRONT PANEL CONNECT 3-ROW BOARD


FRONT PNL CONN VIII ROW
670-3516-
Copyright © 1973, TEKTRONIX, INC
All Rights Reserved
VD-4030-00

A8 FRONT PANEL CONNECT 8-ROW BOARD


A8
A3
A1
A7
A3

(1813) 2338-57

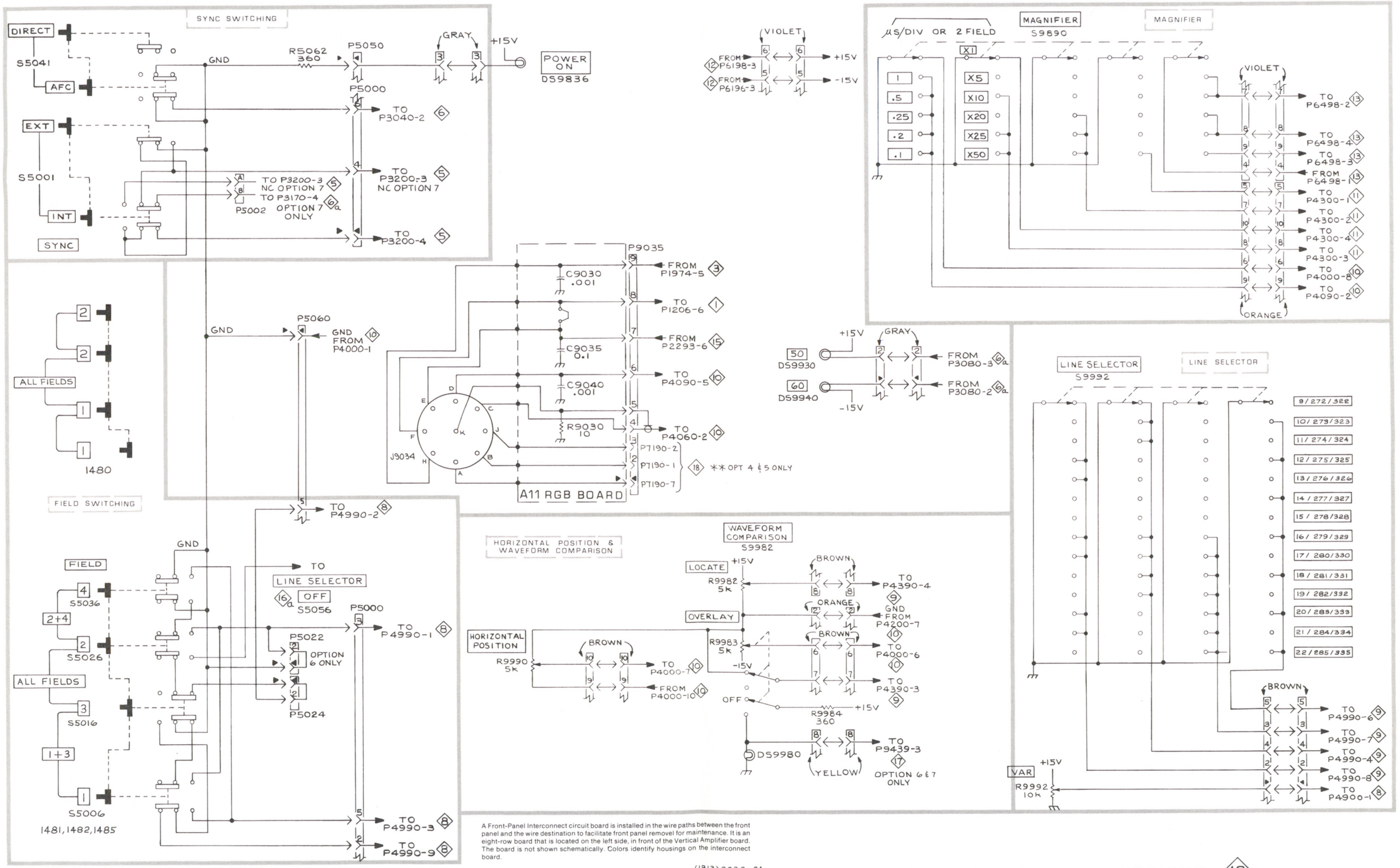


DC RESTORER
DC RESTORER
SLOW
S2210
FAST
S2220
OFF
S2230
DC RESTORER
BACK PORCH
S2250
SYNC TIP
S2255
-15V TO PROBE AMP
+15V TO PROBE AMP
R2272 360
P2212
TO P1898-3 3
FROM P1898-2 3
+15V
FROM P1924-5 3
TO P1696-9 3
FROM P1924-7 3
P2289
TO DS9820 15
P2293
NC
TO P4091-3 7
TO P9035-7 16
P2298
TO P1224-3 1
FROM P1206-5 1
TO P1224-1 1
GND FROM P1949-2 1
TO P4600-1 7
FROM S9815 15
TO S9815 15
CAL/OPER SWITCHING
OPER
S2270
CAL
S2280
RESPONSE
S9915
ORANGE
GREEN
LO PASS
IRE
FLAT
BAND PASS
4.43
3.58
DIFF'D STEP
AUX
TO P4091-1 7
TO P1696-4 2
TO P1696-7 2
TO P1696-3 2
TO P1696-8 2
TO P1696-6 2
TO P1974-1 3
TO P1696-2 2
SEE APRON OF DIA 15 FOR DETAILS OF S9915
RESPONSE SWITCHING
POSITIONING
VERTICAL POSITION
+15V
R9925 5k
-15V
YELLOW
TO P1974-4 3
INPUT
S9815
INPUT SWITCHING
DC CPL'D
AC CPL'D
A
B
A-B
A
B
A-B
PROBE
YELLOW
TO P1028-2 1
TO P1028-3 1
FROM P1028-1 1
WHITE
TO P2293-1 15
FROM P2293-10 15
TO P1206-3 1
TO P1206-2 1
TO P1206-1 1
TO P1206-4 1
YELLOW
A
A/B
TO P3200-1 5
TO P3200-2 5
RED
SYNC
S9190
TO P3200-5 5
ORANGE
CAL VOLTS SWITCHING
P1912
R1913 2.80k
R1914 56.2
R1915 1.15k
R1921 10.7k
R1827 1k
-15V
CAL AMPL
GREEN
BACK PORCH CAL AMPL NTSC (LEFT)
S9955
(RIGHT) PAL
P1912
SCALE ILLUM (PULL FOR EXT)
+15V
R9980 20k
VIOLET
+75V FROM P6296-A1 12
P5060
R5074 100k
P5050
R5072 2.2k
P5050
+15V
BLACK
Q9700
*CABINET MODELS ONLY. NOT USED IN RACK MODELS.
DS9850
DS9855
DS9860
(INT)
(EXT)
WHITE
DS9950
DS9960
S9980
SCALE ILLUMINATION
VOLTS FULL SCALE
S9828
VOLTS FULL SCALE & VARIABLE GAIN
BLUE
1.0
.5
.2
TO P1974-3 3
TO P1949-4 3
TO P1949-3 3
FROM P1686-5 3
S9820
R9821 75.0
GAIN
R9940 100
TO P1686-3 3
TO P1686-1 3
R9828 500
VAR
UNCAL
DS9820
FROM P2289-1 15

525/60—625/50 Dual-Standard models contain both BAND PASS filters and have seven active RESPONSE switch positions. Single-standard models and the 525/60 PAL-M — 525/60 NTSC Dual-Standard model contain one of the BAND PASS filters and have six active RESPONSE switch positions. The last clockwise RESPONSE switch position selects FLAT response.

Front-Panel Interconnect circuit boards are installed in the wire paths between the front panel and the wire destination to facilitate front panel removal for maintenance. The rackmounted models use an eight-row board that is located on the left side, in front of the Vertical Amplifier board. The cabinet models use the eight-row board, and a three-row board located on the lower right side rail, behind the Horizontal Switch board. These boards are not shown schematically. Colors identify housings on the interconnect boards.

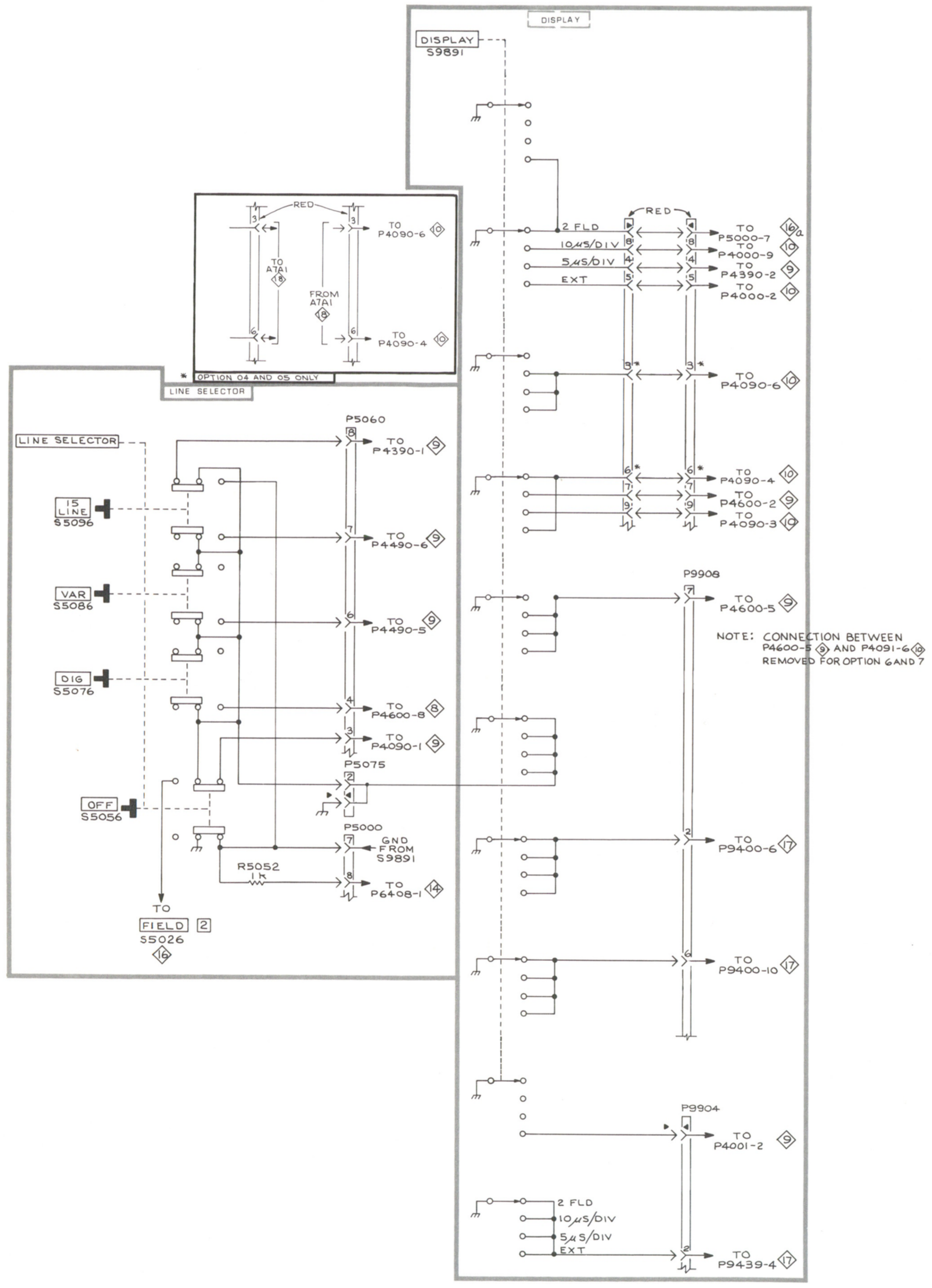
(1813)2338-83
REV FEB 1982


SYNC SWITCHING
DIRECT
S5041
AFC
EXT
S5001
INT
SYNC
GND
R5062
360
P5050
GRAY
+15V
POWER ON
DS9836
P5000
TO P3040-2 6
TO P3200-3 NC OPTION 7 5
TO P3170-4 OPTION 7 ONLY 6a
P5002
TO P3200-3 NC OPTION 7 5
TO P3200-4 5
VIOLET
FROM P6198-3 12
FROM P6196-3 12
+15V
-15V
μS/DIV OR 2 FIELD
MAGNIFIER
S9890
MAGNIFIER
1
.5
.25
.2
.1
X1
X5
X10
X20
X25
X50
VIOLET
TO P6498-2 13
TO P6498-4 13
TO P6498-3 13
FROM P6498-1 13
TO P4300-1 11
TO P4300-2 11
TO P4300-4 11
TO P4300-3 11
TO P4000-8 10
TO P4090-2 10
ORANGE
2
2
ALL FIELDS
1
1
1480
FIELD SWITCHING
GND
P5060
GND FROM P4000-1 10
P9035
C9030
.001
FROM P1974-5 3
TO P1206-6 1
C9035
0.1
FROM P2293-6 15
C9040
.001
TO P4090-5 10
R9030
10
TO P4060-2 10
J9034
P7190-2
P7190-1
P7190-7
18 **OPT 4 & 5 ONLY
A11 RGB BOARD
+15V
GRAY
50
DS9930
60
DS9940
-15V
FROM P3080-3 6a
FROM P3080-2 6a
LINE SELECTOR
S9992
LINE SELECTOR
9/272/322
10/273/323
11/274/324
12/275/325
13/276/326
14/277/327
15/278/328
16/279/329
17/280/330
18/281/331
19/282/332
20/283/333
21/284/334
22/285/335
TO P4990-2 8
FIELD
4
S5036
2+4
2
S5026
ALL FIELDS
3
S5016
1+3
1
S5006
1481,1482,1485
GND
TO LINE SELECTOR
16a OFF
S5056
P5000
TO P4990-1 8
P5022
OPTION 6 ONLY
P5024
TO P4990-3 8
TO P4990-9 8
HORIZONTAL POSITION & WAVEFORM COMPARISON
WAVEFORM COMPARISON
S9982
LOCATE
+15V
R9982
5K
BROWN
TO P4390-4 9
ORANGE
GND FROM P4200-7 10
OVERLAY
HORIZONTAL POSITION
R9990
5K
BROWN
TO P4000-7 10
FROM P4000-10 10
R9983
5K
-15V
BROWN
TO P4000-6 10
TO P4390-3 9
OFF
R9984
360
+15V
DS9980
TO P9439-3 17
OPTION 6 & 7 ONLY
YELLOW
BROWN
TO P4990-6 9
TO P4990-7 9
TO P4990-4 9
TO P4990-8 9
TO P4900-1 8
VAR
+15V
R9992
10K

A Front-Panel Interconnect circuit board is installed in the wire paths between the front panel and the wire destination to facilitate front panel removel for maintenance. It is an eight-row board that is located on the left side, in front of the Vertical Amplifier board. The board is not shown schematically. Colors identify housings on the interconnect board.

(1813) 2338-84
REV B SEP 1980

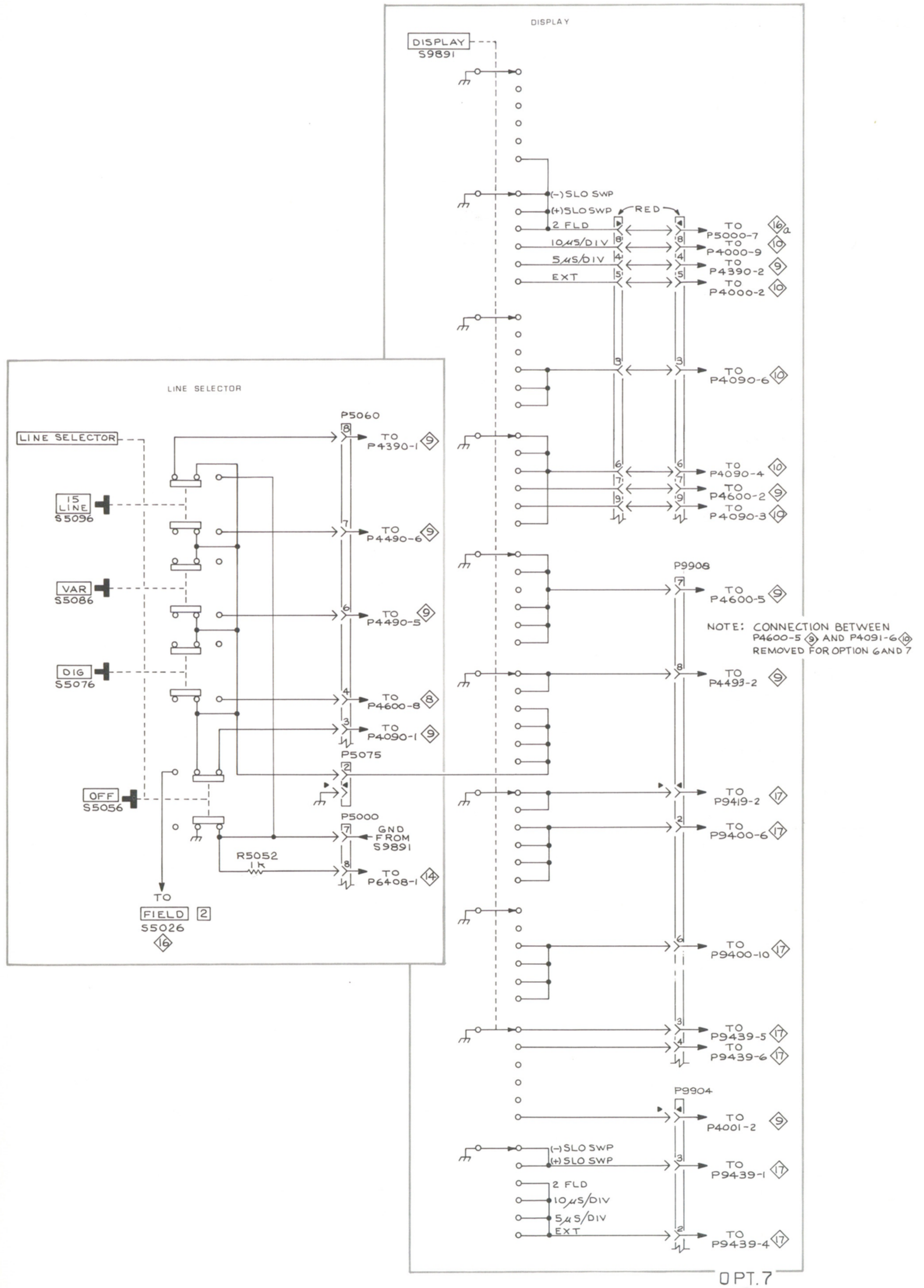
HORIZONTAL SWITCHING 16


DISPLAY
DISPLAY
S9891
2 FLD
10µS/DIV
5µS/DIV
EXT
RED
TO P5000-7 16a
TO P4000-9 10
TO P4390-2 9
TO P4000-2 10
TO P4090-6 10
TO P4090-4 10
TO P4600-2 9
TO P4090-3 10
RED
TO A7A1 18
FROM A7A1 18
TO P4090-6 10
TO P4090-4 10
* OPTION 04 AND 05 ONLY
LINE SELECTOR
LINE SELECTOR
P5060
TO P4390-1 9
15 LINE
S5096
TO P4490-6 9
VAR
S5086
TO P4490-5 9
DIG
S5076
TO P4600-8 9
TO P4090-1 9
P5075
OFF
S5056
P5000
GND FROM S9891
R5052
1k
TO P6408-1 14
TO
FIELD 2
S5026
16
P9908
TO P4600-5 9
NOTE: CONNECTION BETWEEN P4600-5 9 AND P4091-6 10 REMOVED FOR OPTION 6 AND 7
TO P9400-6 17
TO P9400-10 17
P9904
TO P4001-2 9
2 FLD
10µS/DIV
5µS/DIV
EXT
TO P9439-4 17

1480 SERIES (SN B060000-up)

(2338-85)2338-190
REV OCT 1983

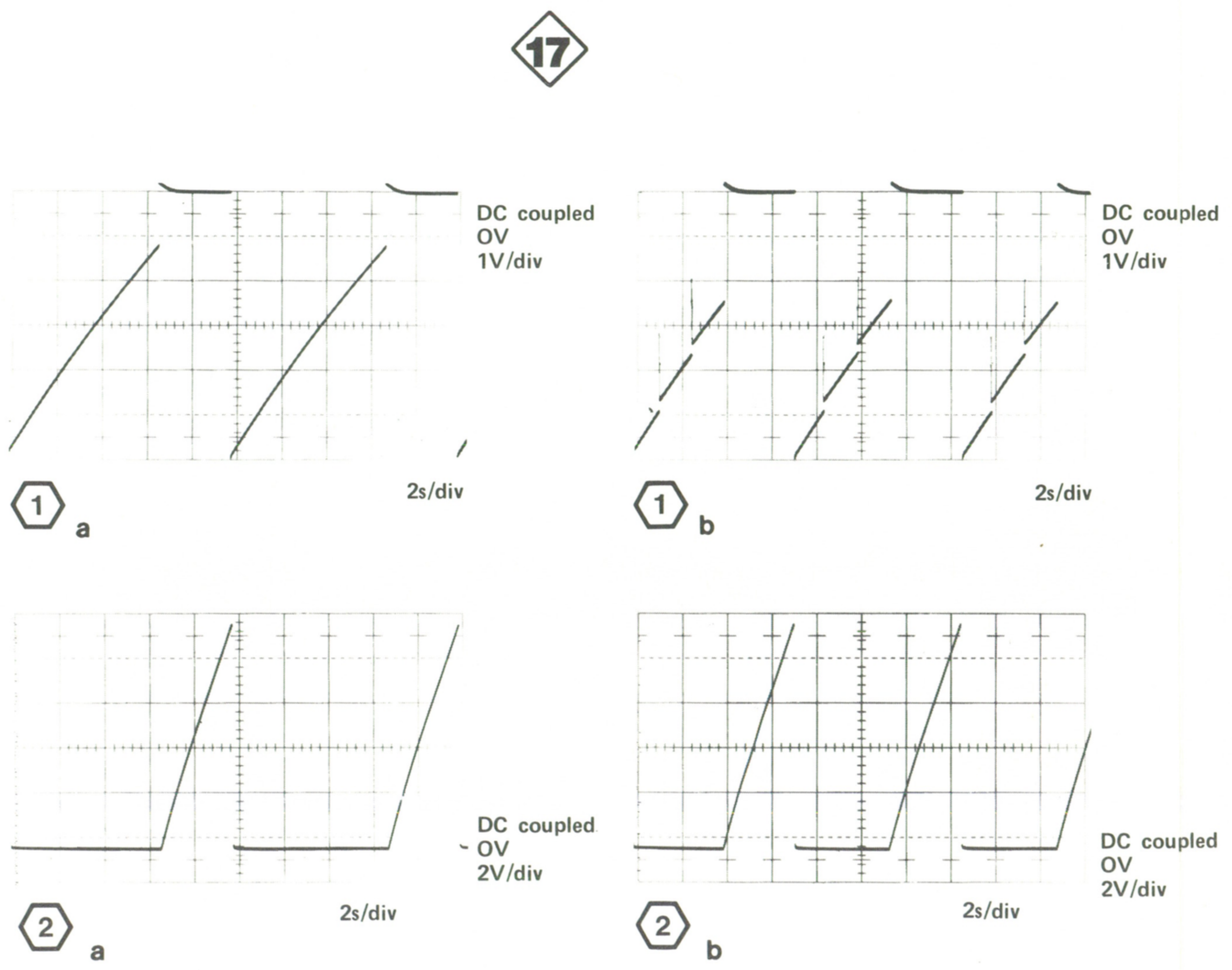
DISPLAY & LINE SELECTOR STD. 16a

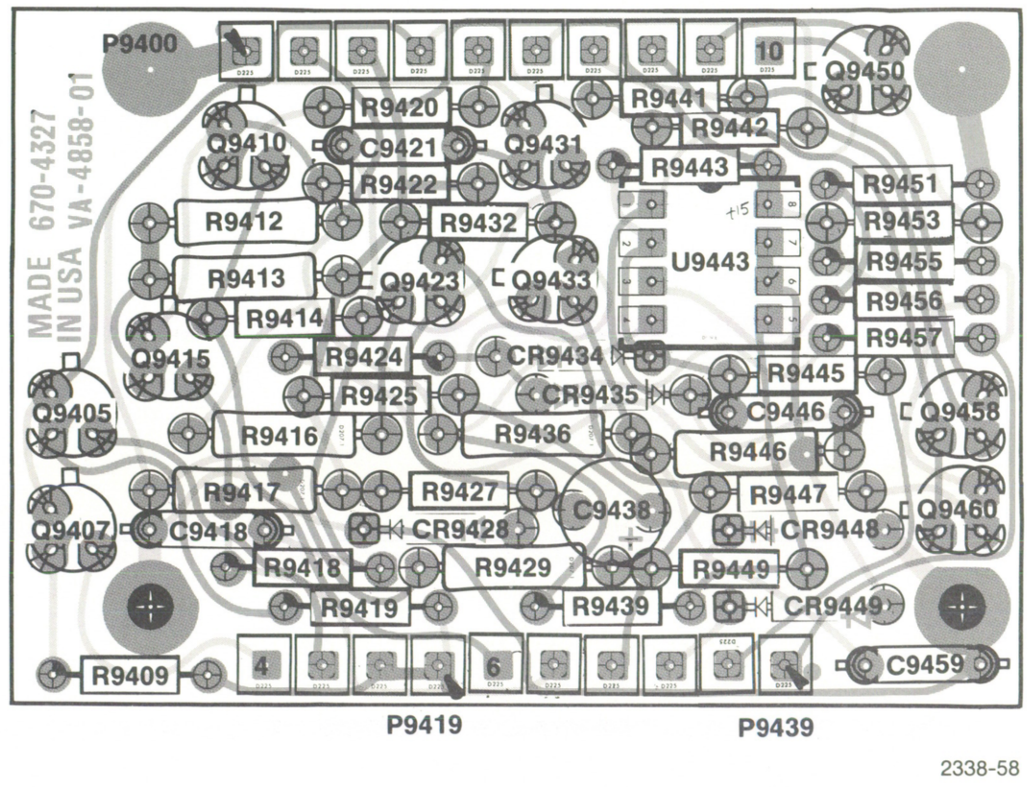

DISPLAY
DISPLAY
S9891
(−) SLO SWP
(+) SLO SWP
2 FLD
10µS/DIV
5µS/DIV
EXT
RED
TO P5000-7 16a
TO P4000-9 10
TO P4390-2 9
TO P4000-2 10
TO P4090-6 10
TO P4090-4 10
TO P4600-2 9
TO P4090-3 10
LINE SELECTOR
LINE SELECTOR
P5060
TO P4390-1 9
15 LINE
S5096
TO P4490-6 9
VAR
S5086
TO P4490-5 9
DIG
S5076
TO P4600-8 9
TO P4090-1 9
P5075
OFF
S5056
P5000
GND FROM S9891
R5052
1k
TO P6408-1 14
TO
FIELD 2
S5026
16
P9908
TO P4600-5 9
NOTE: CONNECTION BETWEEN P4600-5 9 AND P4091-6 10 REMOVED FOR OPTION 6 AND 7
TO P4493-2 9
TO P9419-2 17
TO P9400-6 17
TO P9400-10 17
TO P9439-5 17
TO P9439-6 17
P9904
TO P4001-2 9
(−) SLO SWP
(+) SLO SWP
TO P9439-1 17
2 FLD
10µS/DIV
5µS/DIV
EXT
TO P9439-4 17

1480 SERIES (SN B060000-up)

2338-85
REV NOV 1981

OPT.7
&
DISPLAY & LINE SELECTOR OPT.6 16a




P9400
10
Q9450
MADE IN USA
670-4327
VA-4858-01
R9420
R9441
R9442
Q9410
C9421
Q9431
R9443
R9422
R9451
R9412
R9432
R9453
R9413
Q9423
Q9433
U9443
R9455
R9414
R9456
R9457
Q9415
R9424
CR9434
R9445
Q9405
R9425
CR9435
C9446
Q9458
R9416
R9436
R9446
R9417
R9427
C9438
R9447
Q9460
Q9407
C9418
CR9428
CR9448
R9418
R9429
R9449
R9419
R9439
CR9449
R9409
4
6
C9459
P9419
P9439
2338-58

A13 SLOW SWEEP

TOP

BOTTOM

⟨17⟩

PARTS LOCATING CHART

TRIGGER

C9418
C9421

Q9410
Q9415
Q9431

R9412
R9413
R9414
R9417
R9418

R9420
R9422
R9429
R9432

SWEEP RESET

C9438
C9459

CR9428
CR9448

Q9423
Q9433

R9416
R9425
R9427
R9436
R9446

SYNC SWITCHING

Q9405
Q9407

R9409
R9419

UNBLANKING

Q9458
Q9460

R9441
R9442
R9447

RAMP GENERATOR

C9446

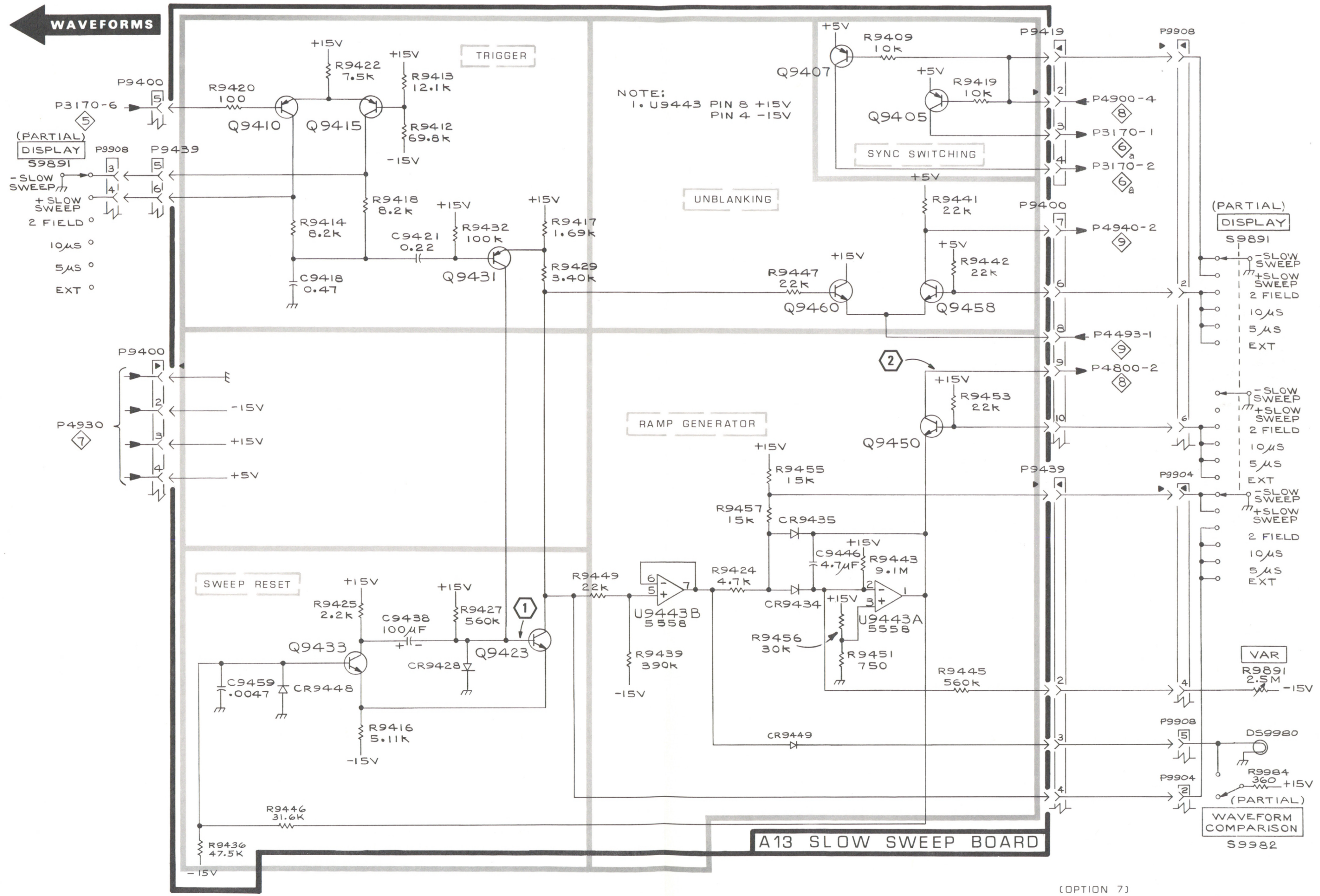
CR9434
CR9435
CR9449

Q9450

R9424
R9439
R9443
R9445
R9449

R9451
R9453
R9455
R9456
R9457

U9443A
U9443B



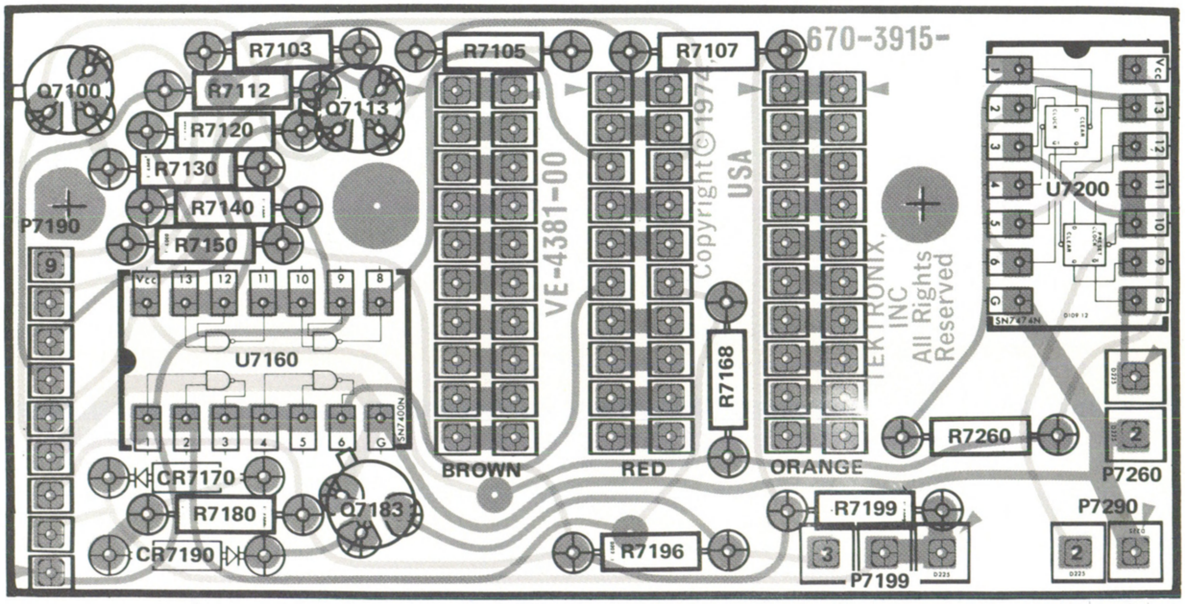
WAVEFORMS
TRIGGER
SYNC SWITCHING
UNBLANKING
RAMP GENERATOR
SWEEP RESET
NOTE:
1. U9443 PIN 8 +15V
PIN 4 -15V
P9400
P3170-6
5
(PARTIAL)
DISPLAY
S9891
P9908
P9439
-SLOW SWEEP
+SLOW SWEEP
2 FIELD
10μS
5μS
EXT
P4930
7
-15V
+15V
+5V
R9420 100
Q9410
Q9415
R9422 7.5k
R9413 12.1k
R9412 69.8k
R9418 8.2k
R9414 8.2k
C9418 0.47
C9421 0.22
R9432 100k
Q9431
R9417 1.69k
R9429 3.40k
Q9407
R9409 10k
Q9405
R9419 10k
P9419
P4900-4
8
P3170-1
6a
P3170-2
6a
R9441 22k
P4940-2
9
R9447 22k
Q9460
Q9458
R9442 22k
P4493-1
9
2
P4800-2
8
R9453 22k
Q9450
R9455 15k
R9457 15k
CR9435
P9904
C9446 4.7μF
R9443 9.1M
R9424 4.7k
CR9434
U9443A 5558
U9443B 5558
R9456 30k
R9451 750
R9449 22k
R9439 390k
R9445 560k
VAR
R9891 2.5M
CR9449
DS9980
R9984 360
(PARTIAL)
WAVEFORM COMPARISON
S9982
R9425 2.2k
Q9433
C9438 100μF
R9427 560k
1
Q9423
CR9428
C9459 .0047
CR9448
R9416 5.11k
R9446 31.6K
R9436 47.5K
A13 SLOW SWEEP BOARD

1480 SERIES (SN B060000-up)

2338-86
REV FEB 1982

(OPTION 7)

SLOW SWEEP ⟨17⟩


R7103
R7105
R7107
670-3915-
Q7100
R7112
Q7113
R7120
R7130
R7140
R7150
P7190
9
VE-4381-00
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USA
TEKTRONIX, INC
All Rights Reserved
U7200
Vcc
13
12
11
10
9
8
U7160
SN7400N
1
2
3
4
5
6
G
R7168
SN7474N
R7260
P7260
BROWN
RED
ORANGE
CR7170
R7180
Q7183
R7199
P7290
CR7190
R7196
3
P7199
2

(1813) 2338-59

A7-1 FRONT PANEL CONNECT 3—ROW (OPTION 04 & 05)

18

PARTS LOCATING CHART

2 FIELD ENABLE

R7120
R7168

U7160A
U7160B
U7160C
U7160D

DC RESTORER CONTROL

CR7170
CR7190

Q7100
Q7183

R7130
R7140
R7150
R7180
R7196
R7199

SYNC GATE

R7103
R7105
R7107
R7112

SYNC ÷2

R7250

U7200A
U7200B

INPUT AMPLIFIER

C4900
C4901
C4913

Q4910
Q4911

R4900
R4910
R4921

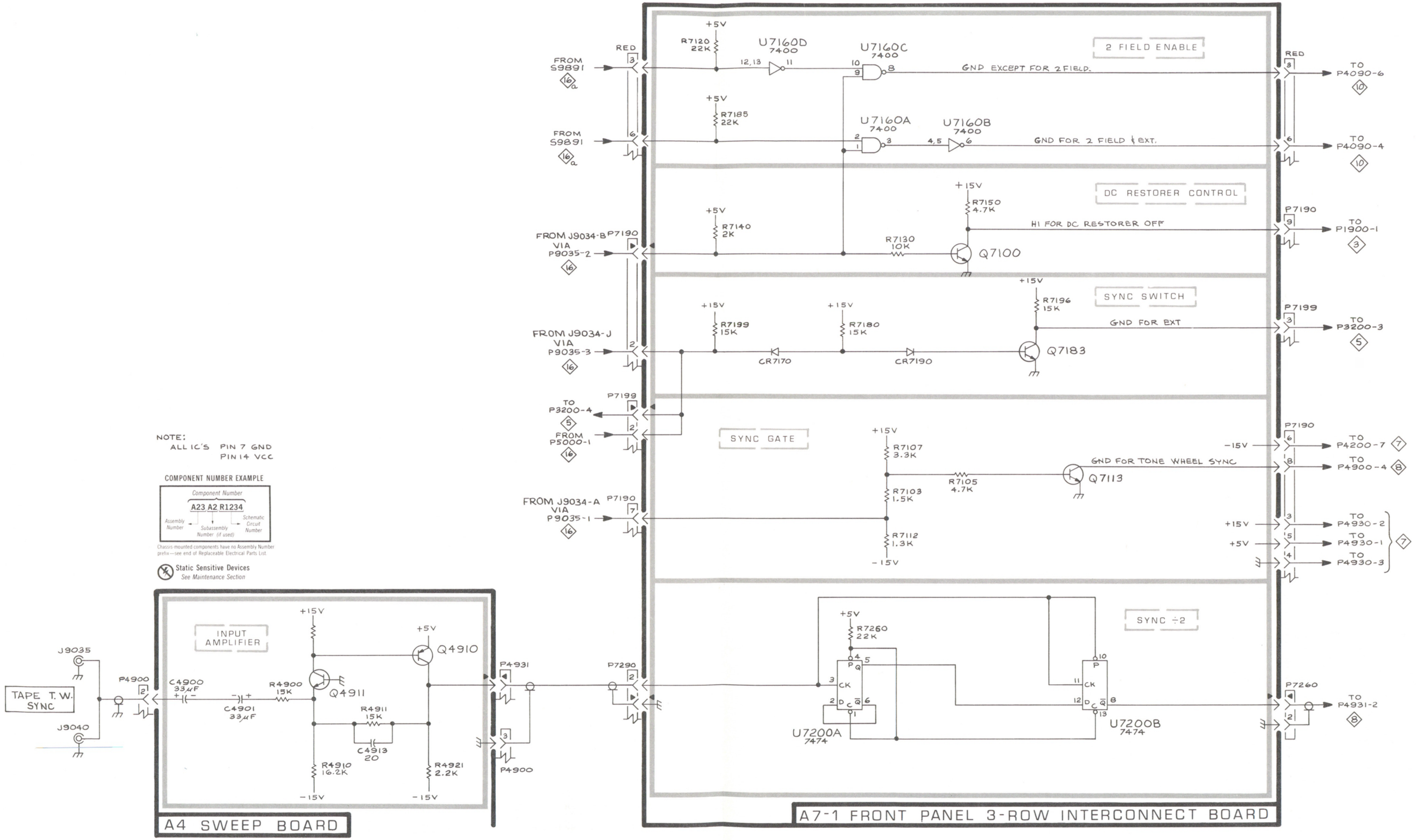
NOTE:
ALL IC'S PIN 7 GND
PIN 14 VCC

COMPONENT NUMBER EXAMPLE

Component Number
A23 A2 R1234
Assembly Number
Subassembly Number (if used)
Schematic Circuit Number

Chassis-mounted components have no Assembly Number prefix—see end of Replaceable Electrical Parts List.

Static Sensitive Devices
See Maintenance Section


+5V
R7120
22K
U7160D
7400
12,13
11
U7160C
7400
10
9
8
2 FIELD ENABLE
RED
FROM S9891
16a
GND EXCEPT FOR 2 FIELD.
TO P4090-6
10
+5V
R7185
22K
U7160A
7400
U7160B
7400
2
1
3
4,5
6
GND FOR 2 FIELD & EXT.
TO P4090-4
DC RESTORER CONTROL
+15V
R7150
4.7K
+5V
R7140
2K
FROM J9034-B VIA P9035-2
P7190
16
R7130
10K
Q7100
HI FOR DC RESTORER OFF
TO P1900-1
3
SYNC SWITCH
+15V
R7196
15K
+15V
R7199
15K
+15V
R7180
15K
FROM J9034-J VIA P9035-3
CR7170
CR7190
Q7183
GND FOR EXT
P7199
TO P3200-3
5
TO P3200-4
FROM P5000-1
SYNC GATE
+15V
R7107
3.3K
R7105
4.7K
Q7113
R7103
1.5K
R7112
1.3K
-15V
FROM J9034-A VIA P9035-1
GND FOR TONE WHEEL SYNC
-15V
TO P4200-7
7
TO P4900-4
8
+15V
TO P4930-2
+5V
TO P4930-1
TO P4930-3
SYNC ÷2
+5V
R7260
22K
P
Q
CK
D
C
Q̄
U7200A
7474
U7200B
7474
P7290
P7260
TO P4931-2
J9035
J9040
TAPE T.W. SYNC
P4900
INPUT AMPLIFIER
+15V
+5V
C4900
33µF
C4901
33µF
R4900
15K
Q4911
Q4910
R4911
15K
C4913
20
R4910
16.2K
R4921
2.2K
-15V
P4931
A4 SWEEP BOARD
A7-1 FRONT PANEL 3-ROW INTERCONNECT BOARD

1480 SERIES (SN B060000-up)

2338-87
REV OCT 1983

TONE WHEEL SYNC INPUT 18
OPTION 04 & 05

REPLACEABLE MECHANICAL PARTS

PARTS ORDERING INFORMATION

Replacement parts are available from or through your local Tektronix, Inc. Field Office or representative.

Changes to Tektronix instruments are sometimes made to accommodate improved components as they become available, and to give you the benefit of the latest circuit improvements developed in our engineering department. It is therefore important, when ordering parts, to include the following information in your order: Part number, instrument type or number, serial number, and modification number if applicable.

If a part you have ordered has been replaced with a new or improved part, your local Tektronix, Inc. Field Office or representative will contact you concerning any change in part number.

Change information, if any, is located at the rear of this manual.

ITEM NAME

In the Parts List, an Item Name is separated from the description by a colon (:). Because of space limitations, an Item Name may sometimes appear as incomplete. For further Item Name identification, the U.S. Federal Cataloging Handbook H6-1 can be utilized where possible.

FIGURE AND INDEX NUMBERS

Items in this section are referenced by figure and index numbers to the illustrations.

INDENTATION SYSTEM

This mechanical parts list is indented to indicate item relationships. Following is an example of the indentation system used in the description column.

1 2 3 4 5 Name & Description

Assembly and/or Component
Attaching parts for Assembly and/or Component
- - - * - - -
Detail Part of Assembly and/or Component
Attaching parts for Detail Part
- - - * - - -
Parts of Detail Part
Attaching parts for Parts of Detail Part
- - - * - - -

Attaching Parts always appear in the same indentation as the item it mounts, while the detail parts are indented to the right. Indented items are part of, and included with, the next higher indentation. The separation symbol - - - * - - - indicates the end of attaching parts.

Attaching parts must be purchased separately, unless otherwise specified.

ABBREVIATIONS

	INCH	ELCTRN	ELECTRON	IN	INCH	SE	SINGLE END
#	NUMBER SIZE	ELEC	ELECTRICAL	INCAND	INCANDESCENT	SECT	SECTION
ACTR	ACTUATOR	ELCTLT	ELECTROLYTIC	INSUL	INSULATOR	SEMICOND	SEMICONDUCTOR
ADPTR	ADAPTER	ELEM	ELEMENT	INTL	INTERNAL	SHLD	SHIELD
ALIGN	ALIGNMENT	EPL	ELECTRICAL PARTS LIST	LPHLDR	LAMPHOLDER	SHLDR	SHOULDERED
AL	ALUMINUM	EQPT	EQUIPMENT	MACH	MACHINE	SKT	SOCKET
ASSEM	ASSEMBLED	EXT	EXTERNAL	MECH	MECHANICAL	SL	SLIDE
ASSY	ASSEMBLY	FIL	FILLISTER HEAD	MTG	MOUNTING	SLFLKG	SELF-LOCKING
ATTEN	ATTENUATOR	FLEX	FLEXIBLE	NIP	NIPPLE	SLVG	SLEEVING
AWG	AMERICAN WIRE GAGE	FLH	FLAT HEAD	NON WIRE	NOT WIRE WOUND	SPR	SPRING
BD	BOARD	FLTR	FILTER	OBD	ORDER BY DESCRIPTION	SQ	SQUARE
BRKT	BRACKET	FR	FRAME or FRONT	OD	OUTSIDE DIAMETER	SST	STAINLESS STEEL
BRS	BRASS	FSTNR	FASTENER	OVH	OVAL HEAD	STL	STEEL
BRZ	BRONZE	FT	FOOT	PH BRZ	PHOSPHOR BRONZE	SW	SWITCH
BSHG	BUSHING	FXD	FIXED	PL	PLAIN or PLATE	T	TUBE
CAB	CABINET	GSKT	GASKET	PLSTC	PLASTIC	TERM	TERMINAL
CAP	CAPACITOR	HDL	HANDLE	PN	PART NUMBER	THD	THREAD
CER	CERAMIC	HEX	HEXAGON	PNH	PAN HEAD	THK	THICK
CHAS	CHASSIS	HEX HD	HEXAGONAL HEAD	PWR	POWER	TNSN	TENSION
CKT	CIRCUIT	HEX SOC	HEXAGONAL SOCKET	RCPT	RECEPTACLE	TPG	TAPPING
COMP	COMPOSITION	HLCPS	HELICAL COMPRESSION	RES	RESISTOR	TRH	TRUSS HEAD
CONN	CONNECTOR	HLEXT	HELICAL EXTENSION	RGD	RIGID	V	VOLTAGE
COV	COVER	HV	HIGH VOLTAGE	RLF	RELIEF	VAR	VARIABLE
CPLG	COUPLING	IC	INTEGRATED CIRCUIT	RTNR	RETAINER	W/	WITH
CRT	CATHODE RAY TUBE	ID	INSIDE DIAMETER	SCH	SOCKET HEAD	WSHR	WASHER
DEG	DEGREE	IDENT	IDENTIFICATION	SCOPE	OSCILLOSCOPE	XFMR	TRANSFORMER
DWR	DRAWER	IMPLR	IMPELLER	SCR	SCREW	XSTR	TRANSISTOR

CROSS INDEX—MFR. CODE NUMBER TO MANUFACTURER

Mfr. Code	Manufacturer	Address	City, State, Zip
0000G	J.L.O. METAL PRODUCTS	2001 N PARKSIDE	CHICAGO, IL 60639
000BK	STAUFFER SUPPLY	105 SE TAYLOR	PORTLAND, OR 97214
000CY	NORTHWEST FASTENER SALES, INC.	7923 SW CIRRUS DRIVE	BEAVERTON, OR 97005
00779	AMP, INC.	P.O. BOX 3608	HARRISBURG, PA 17105
02660	BUNKER RAMO CORP., CONNECTOR DIVISION	2801 S 25TH AVENUE	BROADVIEW, IL 60153
04866	NYLOK-DETROIT CORPORATION	1754 MAPLELAWN	TROY, MI 48084
05820	WAKEFIELD ENGINEERING, INC.	AUDUBON ROAD	WAKEFIELD, MA 01880
06666	GENERAL DEVICES CO., INC.	525 S. WEBSTER AVE.	INDIANAPOLIS, IN 46219
07263	FAIRCHILD SEMICONDUCTOR, A DIV. OF FAIRCHILD CAMERA AND INSTRUMENT CORP.	464 ELLIS STREET	MOUNTAIN VIEW, CA 94042
09422	PLASTIC STAMPING CORPORATION	2216 W. ARMITAGE AVE.	CHICAGO, IL 60647
09922	BURNDY CORPORATION	RICHARDS AVENUE	NORWALK, CT 06852
11897	PLASTIGLIDE MFG. CORPORATION	P O BOX 867, 1757 STANFORD ST.	SANTA MONICA, CA 90406
12327	FREEWAY CORPORATION	9301 ALLEN DRIVE	CLEVELAND, OH 44125
12697	CLAROSTAT MFG. CO., INC.	LOWER WASHINGTON STREET	DOVER, NH 03820
13511	AMPHENOL CARDRE DIV., BUNKER RAMO CORP.		LOS GATOS, CA 95030
16428	BELDEN CORP.	P. O. BOX 1331	RICHMOND, IN 47374
18722	RCA CORP., SOLID STATE DIVISION	CRESTWOOD ROAD	MOUNTAINTOP, PA 18707
22526	BERG ELECTRONICS, INC.	YOUK EXPRESSWAY	NEW CUMBERLAND, PA 17070
24931	SPECIALITY CONNECTOR CO., INC.	2620 ENDRESS PLACE	GREENWOOD, IN 46142
28520	HEYMAN MFG. CO.	147 N. MICHIGAN AVE.	KENILWORTH, NJ 07033
31223	MICRO PLASTICS, INC.	20821 DEARBORN STREET	CHATSWORTH, CA 91311
45722	USM CORP., PARKER-KALON FASTENER DIV.		CAMPBELLSVILLE, KY 42718
46384	PENN ENGINEERING AND MFG. CORP.	P O BOX 311	DOYLESTOWN, PA 18901
49671	RCA CORPORATION	30 ROCKEFELLER PLAZA	NEW YORK, NY 10020
52905	SIMPLEX MFG. COMPANY	5224 NE 42ND AVENUE	PORTLAND, OREGON 97218
55292	LEDCO DIV., WILBRECHT ELECTRONICS, INC.	240 EAST PLATO BLVD.	ST. PAUL, MN 55107
57668	R-OHM CORP.	16931 MILLIKEN AVE.	IRVINE, CA 92713
57771	STIMPSON, EDWIN B.,CO. INC.	900 SYLVAN AVENUE	BAYPORT, NY 11705
70318	ALLMETAL SCREW PRODUCTS CO., INC.	821 STEWART AVE.	GARDEN CITY, NY 11530
70485	ATLANTIC INDIA RUBBER WORKS, INC.	571 W. POLK ST.	CHICAGO, IL 60607
70903	BELDEN CORP.	2000 S BATAVIA AVENUE	GENEVA, IL 60134
71159	BRISTOL SOCKET SCREW, DIV. OF AMERICAN CHAIN AND CABLE CO., INC.	P O BOX 2244, 40 BRISTOL ST.	WATERBURY, CT 06720
71400	BUSSMAN MFG., DIVISION OF MCGRAW-EDISON CO.	2536 W. UNIVERSITY ST.	ST. LOUIS, MO 63107
71590	CENTRALAB ELECTRONICS, DIV. OF GLOBE-UNION, INC.	P O BOX 858	FORT DODGE, IA 50501
71785	TRW, CINCH CONNECTORS	1501 MORSE AVENUE	ELK GROVE VILLAGE, IL 60007
73743	FISCHER SPECIAL MFG. CO.	446 MORGAN ST.	CINCINNATI, OH 45206
74445	HOLO-KROME CO.	31 BROOK ST. WEST	HARTFORD, CT 06110
74921	ITEN FIBRE CO.,	4001 BENEFIT AVE., P O BOX 9	ASHTABULA, OH 44004
74970	JOHNSON, E. F., CO.	299 10TH AVE. S. W.	WASECA, MN 56093
75915	LITTELFUSE, INC.	800 E. NORTHWEST HWY	DES PLAINES, IL 60016
77132	DOT FASTENER CO., A UNITED-CARR DIV. OF TRW INC.	ROUND HOUSE INDL PK,PO BOX 710	WATERBURY, CT 06720
77900	SHAKEPROOF DIV OF ILLINOIS TOOL WORKS	SAINT CHARLES RD	ELGIN, IL 60120
78189	ILLINOIS TOOL WORKS, INC. SHAKEPROOF DIVISION	ST. CHARLES ROAD	ELGIN, IL 60120
79136	WALDES, KOHINOOR, INC.	47-16 AUSTEL PLACE	LONG ISLAND CITY, NY 11101
79807	WROUGHT WASHER MFG. CO.	2100 S. O BAY ST.	MILWAUKEE, WI 53207
80009	TEKTRONIX, INC.	P O BOX 500	BEAVERTON, OR 97077
83385	CENTRAL SCREW CO.	2530 CRESCENT DR.	BROADVIEW, IL 60153
83903	ACCURATE DIE AND STAMPING DIV., ALLIED PRODUCTS CORP.	1947 N. MAUD AVE.	CHICAGO, IL 60614
85471	BOYD, A. B., CO.	2527 GRANT AVENUE	SAN LEANDRO, CA 94579
85703	JOSLYN STAMPING COMPANY	1020 WALLACE PLACE	CITY OF INDUSTRY, CA 91748
86445	PENN FIBRE AND SPECIALTY CO., INC.	2032 E. WESTMORELAND ST.	PHILADELPHIA, PA 19134
86928	SEASTROM MFG. COMPANY, INC.	701 SONORA AVENUE	GLENDALE, CA 91201
87308	N. L. INDUSTRIES, INC., SOUTHERN SCREW DIV.	P. O. BOX 1360	STATESVILLE, NC 28677
93907	TEXTRON INC. CAMCAR DIV	600 18TH AVE	ROCKFORD, IL 61101
95263	LEECRAFT MFG. CO., INC.	21-16 44TH RD.	LONG ISLAND CITY, NY 11101
95712	BENDIX CORP., THE ELECTRICAL COMPONENTS DIV., MICROWAVE DEVICES PLANT	HURRICANE ROAD	FRANKLIN, IN 46131
95987	WECKESSER CO., INC.	4444 WEST IRVING PARK RD.	CHICAGO, IL 60641
S3109	C/O PANEL COMPONENTS CORP.	P.O. BOX 6626	SANTA ROSA, CA 95406

CROSS INDEX—MFR. CODE NUMBER TO MANUFACTURER

Mfr. Code	Manufacturer	Address	City, State, Zip
S3629	PANEL COMPONENTS CORP.	2015 SECOND ST	BERKELEY, CA 94170
T0435	LEWIS SCREW CO.	4114 SOUTH PERORIA AVE.	CHICAGO, IL 60609

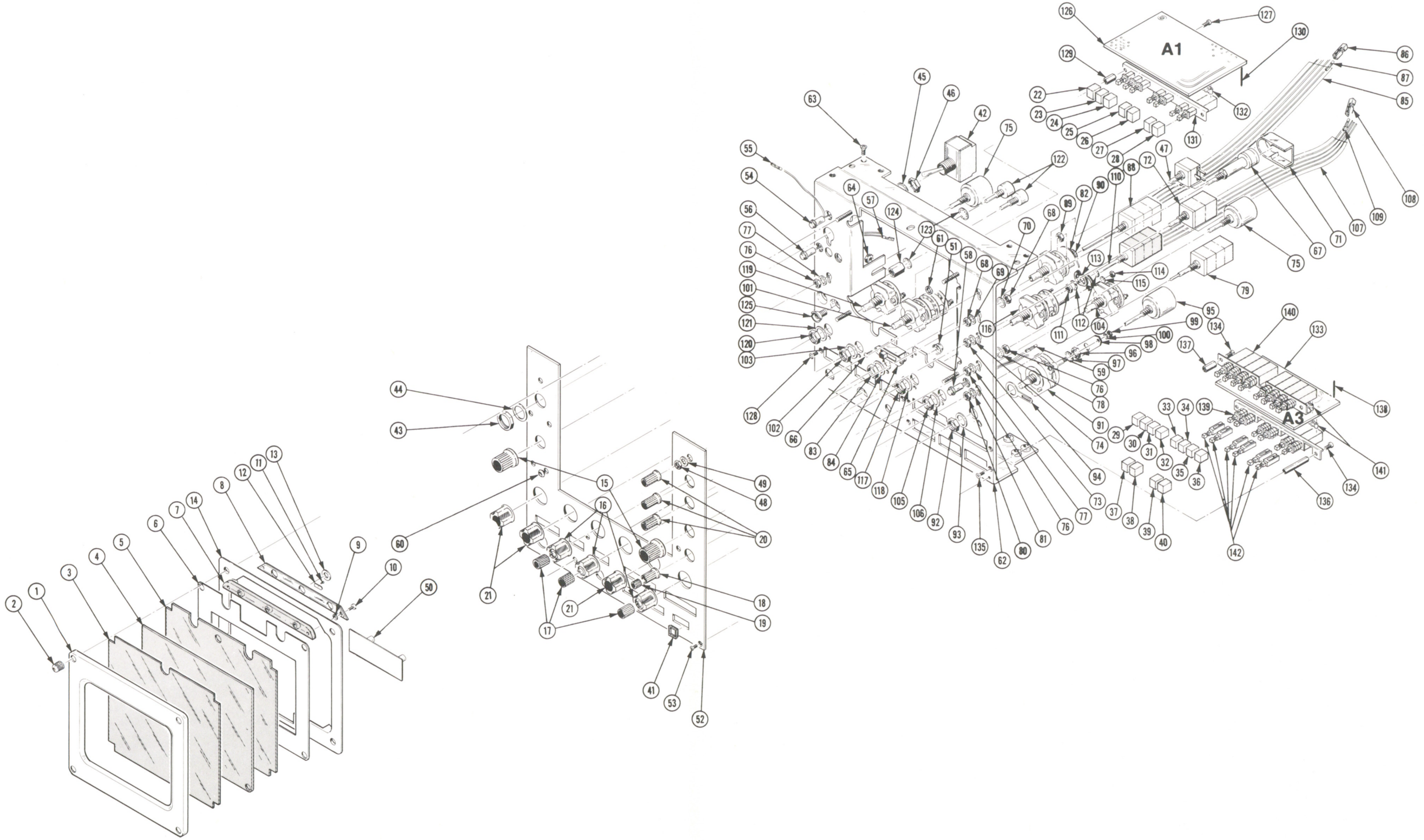
Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
1-1	200-1711-00			1	RTNR,CRT SCALE:5.5 X 5.0,AL TV GRAY	80009	200-1711-00
					**************(ATTACHING PARTS)***********		
-2	210-0434-00			4	NUT,PLAIN,KNURL:10-32 X 0.375 INCH	80009	210-0434-00
					************(END ATTACHING PARTS)*********		
-3	378-0560-00			1	FILTER,LT,CRT:SMK GY,5.4 X 4.375 X 0.03	80009	378-0560-00
-4	337-2216-00			1	SHIELD,ELEC:(FOR 1480 SERIES)	80009	337-2216-00
-5	331-0393-00			1	SCALE,CRT:BLANK,CLEAR	80009	331-0393-00
	331-0393-05			1	SCALE,CRT:CCIR K FACTOR ,VISUAL,CLEAR	80009	331-0393-05
	----- -----			-	(1481C,1485C ONLY)		
	331-0393-07	B073222		1	SCALE,CRT:CCIR K FACTOR,PHOTO,CLEAR	80009	331-0393-07
	----- -----			-	(1481C,,1485C ONLY)		
	331-0393-08	B073222		1	SCALE,CRT:EXT,NTSC,A 100%,CLEAR	80009	331-0393-08
	----- -----			-	(1485C ONLY)		
	331-0393-10	B073222		1	SCALE,CRT:EXT,NTSC A PHOTO,CLEAR	80009	331-0393-10
	----- -----			-	(1485C ONLY)		
	331-0393-17	B073222		1	SCALE,CRT:IEEE STANDARD 511-1979	80009	331-0393-17
	----- -----			-	(1480C,1482R,1485C ONLY)		
	331-0393-18	B073222		1	SCALE,CRT:IEEE STANDARD 511-1979,PHOT	80009	331-0393-18
	----- -----			-	(1480C,1482R,1485C ONLY)		
-6	331-0399-00			1	MASK,CRT SCALE:	80009	331-0399-00
-7	378-0614-00			1	REFLECTOR,LIGHT:MOLDED PLASTIC	80009	378-0614-00
-8	----- -----			1	CKT BOARD ASSY:CRT SCALE LIGHT		
	----- -----			-	(SEE A14 REPL)		
					**************(ATTACHING PARTS)***********		
-9	210-0994-00			2	WASHER,FLAT:0.125 ID X 0.25" OD,STL	86928	5702-201-20
-10	211-0062-00			2	SCREW,MACHINE:2-56 X 0.312,PNH,STL	83385	ORD BY DESCR
					************(END ATTACHING PARTS)*********		
	----- -----			-	CKT BOARD ASSY INCLUDES:		
-11	210-0759-00			3	.EYELET,METALLIC:0.61 OD X 0.192 INCH L,BR	71590	30818-11
-12	131-0704-00			3	.CONTACT,ELEC:SCALE LIGHTS,CU BE	80009	131-0704-00
-13	210-0957-00			3	.WASHER,FLAT:0.0625 ID X 0.125" OD,STL	83903	ORD BY DESCR
-14	331-0405-00			1	MASK,CRT SCALE:	80009	331-0405-00
-15	366-0497-00			2	KNOB:GY,0.127 ID X 0.706 OD	80009	366-0497-00
	213-0153-00			2	.SETSCREW:5-40 X 0.125,STL BK OXD,HEX	000CY	ORD BY DESCR
-16	366-1170-01			3	KNOB:GRAY,4 SIDED	80009	366-1170-01
	213-0153-00			6	.SETSCREW:5-40 X 0.125,STL BK OXD,HEX	000CY	ORD BY DESCR
-17	366-1023-02			3	KNOB:GRAY--VAR	80009	366-1023-02
	213-0153-00			3	.SETSCREW:5-40 X 0.125,STL BK OXD,HEX	000CY	ORD BY DESCR
-18	366-1077-00			1	KNOB:GRAY	80009	366-1077-00
	213-0153-00			2	.SETSCREW:5-40 X 0.125,STL BK OXD,HEX	000CY	ORD BY DESCR
-19	366-1319-02			1	KNOB:GY,0.79 ID,0.28 OD,0.32 H	80009	366-1319-02
	213-0239-00			1	.SETSCREW:3-48 X 0.062 INCH,HEX SOC	71159	ORD BY DESCR
-20	366-1189-00			3	KNOB:GY,0.127 ID X 0.5 OD X 0.53	80009	366-1189-00
	213-0153-00			3	.SETSCREW:5-40 X 0.125,STL BK OXD,HEX	000CY	ORD BY DESCR
-21	366-1190-00			3	KNOB:GRAY	80009	366-1190-00
	213-0153-00			6	.SETSCREW:5-40 X 0.125,STL BK OXD,HEX	000CY	ORD BY DESCR
-22	366-1328-30			1	PUSH BUTTON:SLOW	80009	366-1328-30
-23	366-1489-97			1	PUSH BUTTON:FAST	80009	366-1489-97
-24	366-1402-98			1	PUSH BUTTON:OFF	80009	366-1402-98
-25	366-1328-35			1	PUSH BUTTON:BACK PORCH	80009	366-1328-35
-26	366-1557-01			1	PUSH BUTTON:SYNC TIP	80009	366-1557-01
-27	366-1328-34			1	PUSH BUTTON:OPERATE	80009	366-1328-34
-28	366-1489-98			1	PUSH BUTTON:CAL	80009	366-1489-98
-29	366-1328-31			1	PUSH BUTTON:"1"	80009	366-1328-31
	----- -----			-	(1480,1481,1482,1485,OPTS 01 & 07 ONLY)		
-30	366-1328-32			1	PUSH BUTTON:CHARCOAL,3	80009	366-1328-32
	----- -----			-	(1481,1482,1485,OPT 01 & 07 ONLY)		
-31	366-1489-99			3	PUSH BUTTON:"2"	80009	366-1489-99
	----- -----			-	(1480,1481,1482,1485,OPT 01 & 07 ONLY)		
-32	366-1557-00			1	PUSH BUTTON:SIL GY,4	80009	366-1557-00
	----- -----			-	(1481,1482,1485,OPT 01 & 07 ONLY)		
-33	366-1328-29			1	PUSH BUTTON:OFF	80009	366-1328-29
-34	366-1557-03			1	PUSH BUTTON:DIG	80009	366-1557-03
-35	366-1557-02			1	PUSH BUTTON:VAR	80009	366-1557-02

Fig & Index No	Tektronix Part No.	Serial Model No Eff	Serial Model No Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
1-36	366-1557-04			1	PUSH BUTTON:15 LINES	80009	366-1557-04
-37	366-1328-33			1	PUSH BUTTON:INT	80009	366-1328-33
-38	366-1489-43			1	PUSH BUTTON:SIL GY,EXT	80009	366-1489-43
-39	366-1328-36			1	PUSH BUTTON:AFC	80009	366-1328-36
-40	366-1489-96			1	PUSH BUTTON:DIRECT	80009	366-1489-96
-41	426-0681-01			19	FRAME,PUSH BTN:	80009	426-0681-01
-42	----- -----				SWITCH,TOGGLE:(SEE S9836 REPL)		
					**************(ATTACHING PARTS)************		
-43	210-0473-00			1	NUT,PLAIN,DODEC:0.469-32 X 0.638 INCH,BRS	80009	210-0473-00
-44	210-0902-00			1	WASHER,FLAT:0.470 ID X 0.656 INCH OD,ST	12327	ORD BY DESCR
	210-0021-00	B061655		1	WASHER,LOCK:INTL,0.476IDX0.018THK,STL	78189	1222-01
-45	354-0055-00			1	WASHER,KEY:0.469 ID X 0.688 INCH OD,ST	80009	354-0055-00
	210-0021-00	B061655		1	WASHER,LOCK:INTL,0.476IDX0.018THK,STL	78189	1222-01
-46	210-0414-00			1	NUT,PLAIN,HEX.:0.468-32 X 0.562 INCH,BRS	73743	3167-402
					***********(END ATTACHING PARTS)**********		
-47	----- -----			1	RES.,VARIABLE:(SEE R9880 REPL)		
					**************(ATTACHING PARTS)************		
-48	210-0583-00			1	NUT,PLAIN,HEX:0.25-32 X 0.312 INCH,BRS	73743	2X20317-402
-49	210-0940-00			1	WASHER,FLAT:0.25 ID X 0.375 INCH OD,STL	79807	ORD BY DESCR
					***********(END ATTACHING PARTS)**********		
-50	200-1777-00			1	COVER,CONN HOLE:PROBE	80009	200-1777-00
					**************(ATTACHING PARTS)************		
-51	220-0743-00			2	NUT,STAMPED:0.187 THD X 0.217 H,CD PL	80009	220-0743-00
					***********(END ATTACHING PARTS)**********		
-52	333-1962-02			1	PANEL,FRONT:1480C	80009	333-1962-02
	333-1964-02	B060000	B061354	1	PANEL,FRONT:1481C	80009	333-1964-02
	333-1964-04	B061355		1	PANEL,FRONT:1481C	80009	333-1964-04
	333-1966-02	B060000	B061354	1	PANEL,FRONT:1482C	80009	333-1966-02
	333-1966-04	B061355		1	PANEL,FRONT:1482C	80009	333-1966-04
	333-1970-02	B060000	B061354	1	PANEL,FRONT:1485C	80009	333-1970-02
	333-1970-04	B061355		1	PANEL,FRONT:1485C	80009	333-1970-04
					**************(ATTACHING PARTS)************		
-53	213-0254-00			2	SCREW,TPG,TF:2-32 X 0.250,100 DEG,FLH	45722	ORD BY DESCR
					***********(END ATTACHING PARTS)**********		
-54	150-0123-03			1	LAMP,CARTRIDGE:14V,23MA	55292	71523-02
-55	131-0707-00			1	.CONTACT,ELEC:22-26 AWG,BRS & CU BE GOLD	22526	47439-000
-56	150-0123-00			2	LAMP,CARTRIDGE:14V,23MA,WHITE	55292	72323-14
-57	131-0707-00			2	.CONTACT,ELEC:22-26 AWG,BRS & CU BE GOLD	22526	47439-000
-58	150-0123-02			3	LAMP,CARTRIDGE:14V,23MA,RED	55292	71523-01
-59	131-0621-00			1	.CONNECTOR,TERM:22-26 AWG,BRS & CU BE GOLD	22526	46231-000
-60	358-0301-00			2	BUSHING,SLEEVE:FOR 0.185 DIA HOLE,GRAY	80009	358-0301-00
-61	210-0844-00			4	WASHER,FLAT:0.218 ID X 0.078 THK,NPRN	86928	ORD BY DESCR
-62	386-3081-00	B060000	B061354	1	SUBPANEL,FRONT:	80009	386-3081-00
	386-3081-01	B061355		1	SUBPANEL,FRONT:	80009	386-3081-01
					**************(ATTACHING PARTS)************		
-63	211-0538-00			8	SCREW,MACHINE:6-32 X 0.312 100 DEG,FLH	83385	ORD BY DESCR
-64	210-0457-00			2	NUT,PL,ASSEM WA:6-32 X 0.312 STL CD PL	83385	ORD BY DESCR
					***********(END ATTACHING PARTS)**********		
-65				1	SWITCH,SLIDE:(SEE S9955 REPL)		
					**************(ATTACHING PARTS)************		
-66	211-0022-00			2	SCREW,MACHINE:2-56 X 0.188,PNH,STL,CD PL	83385	ORD BY DESCR
					***********(END ATTACHING PARTS)**********		
-67				1	RES.,VARIABLE:(SEE R9882 REPL)		
					**************(ATTACHING PARTS)************		
-68	210-0583-00			2	NUT,PLAIN,HEX:0.25-32 X 0.312 INCH,BRS	73743	2X20317-402
-69	210-0940-00			1	WASHER,FLAT:0.25 ID X 0.375 INCH OD,STL	79807	ORD BY DESCR
-70	210-0046-00			1	WASHER,LOCK:0.261 ID,INTL,0.018 THK,BRS	77900	1214-05-00-0541C
					***********(END ATTACHING PARTS)**********		
-71	200-0608-00			1	COVER,VAR RES.,:PLASTIC:	80009	200-0608-00

Fig. & Index No.	Tektronix Part No.	Serial/Model No.		Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
		Eff	Dscont				
1-72	----- -----			1	RES.,VARIABLE:(SEE R9980 REPL)		
					*************(ATTACHING PARTS)***********		
-73	210-0583-00			1	NUT,PLAIN,HEX:0.25-32 X 0.312 INCH,BRS	73743	2X20317-402
-74	210-0940-00			1	WASHER,FLAT:0.25 ID X 0.375 INCH OD,STL	79807	ORD BY DESCR
					***********(END ATTACHING PARTS)*********		
-75	----- -----			2	RES.,VARIABLE:(SEE R9925,R9990 REPL)		
					*************(ATTACHING PARTS)***********		
-76	210-0583-00			4	NUT,PLAIN,HEX:0.25-32 X 0.312 INCH,BRS	73743	2X20317-402
	210-0807-00	B062816		2	WASHER,FLAT:0.312 ID X 0.05 THK,STL	12327	ORD BY DESCR
	----- -----			-	(CABINET ONLY)		
	210-0807-00	B068105		2	WASHER,FLAT:0.312 ID X 0.05 THK,STL	12327	ORD BY DESCR
	----- -----			-	(RACKMOUNT ONLY)		
-77	210-0940-00			2	WASHER,FLAT:0.25 ID X 0.375 INCH OD,STL	79807	ORD BY DESCR
-78	210-0046-00			2	WASHER,LOCK:0.261 ID,INTL,0.018 THK,BRS	77900	1214-05-00-0541C
					***********(END ATTACHING PARTS)*********		
-79	----- -----			1	RES.,VAR:(SEE R9982 REPL)		
					*************(ATTACHING PARTS)***********		
-80	210-0583-00			1	NUT,PLAIN,HEX:0.25-32 X 0.312 INCH,BRS	73743	2X20317-402
-81	210-0940-00			1	WASHER,FLAT:0.25 ID X 0.375 INCH OD,STL	79807	ORD BY DESCR
					***********(END ATTACHING PARTS)*********		
-82	----- -----				SWITCH,ROTARY:(SEE S9828 REPL)		
					*************(ATTACHING PARTS)***********		
-83	210-0590-00			1	NUT,PLAIN,HEX.:0.375-32 X 0.438" BRS	73743	2X28269-402
-84	210-0978-00			1	WASHER,FLAT:0.375 ID X 0.50 INCH OD,STL	12327	ORD BY DESCR
					***********(END ATTACHING PARTS)*********		
-85	195-0144-00			1	LEAD SET,ELEC:FRONT PANEL CONTROL	80009	195-0144-00
-86	352-0197-00			3	.CONN BODY,PL,EL:1 WIRE BLACK	80009	352-0197-00
-87	131-0621-00			3	.CONNECTOR,TERM:22-26 AWG,BRS & CU BE GOLD	22526	46231-000
-88	----- -----			1	RES.,VARIABLE:(SEE R9828 REPL)		
					*************(ATTACHING PARTS)***********		
-89	210-0465-00			1	NUT,PLAIN,HEX :0.25-32 X 0.375 INCH BRS	73743	3095-402
-90	210-0046-00			1	WASHER,LOCK:0.261 ID,INTL,0.018 THK,BRS	77900	1214-05-00-0541C
					***********(END ATTACHING PARTS)*********		
-91	----- -----			-	SWITCH,ROTARY:(SEE S9992,R9981 REPL)		
					*************(ATTACHING PARTS)***********		
-92	210-0590-00			1	NUT,PLAIN,HEX.:0.375-32 X 0.438" BRS	73743	2X28269-402
-93	210-0978-00			1	WASHER,FLAT:0.375 ID X 0.50 INCH OD,STL	12327	ORD BY DESCR
-94	210-0207-00			1	TERMINAL,LUG:0.375 INCH DIAMETER	12697	01136902
					***********(END ATTACHING PARTS)*********		
-95	----- -----			1	RES.,VARIABLE:(SEE R9992 REPL)		
					*************(ATTACHING PARTS)***********		
-96	210-0465-00			1	NUT,PLAIN,HEX.:0.25-32 X 0.375 INCH BRS	73743	3095-402
-97	210-0046-00	B060000	B073159	1	WASHER,LOCK:0.261 ID,INTL,0.018 THK,BRS	77900	1214-05-00-0541C
	210-1026-00	B073160		1	WASHER,LOCK:0.26 ID,INTL,0.025 THK,STL	78189	1114-00
					***********(END ATTACHING PARTS)*********		
-98	386-3476-00	B060000	B073159	1	PLATE,CMPNT MTG:RESISTOR	80009	386-3476-00
	386-3476-01	B073160		1	PLATE,CMPNT MTG:RESISTOR	80009	386-3476-01
					*************(ATTACHING PARTS)***********		
-99	210-0406-00			2	NUT,PLAIN,HEX:4-40 X 0.188,BRS,CD PL	73743	12161-50
-100	210-0004-00			2	WASHER,LOCK:#4 INTL,0.015 THK,STL CD PL	77900	1204-00-000541C
					***********(END ATTACHING PARTS)*********		
-101	----- -----			-	SWITCH,ROTARY:(SEE S9815 REPL)		
					*************(ATTACHING PARTS)***********		
-102	210-0590-00			1	NUT,PLAIN,HEX.:0.375-32 X 0.438" BRS	73743	2X28269-402
-103	210-0978-00			1	WASHER,FLAT:0.375 ID X 0.50 INCH OD,STL	12327	ORD BY DESCR
					***********(END ATTACHING PARTS)*********		
-104	----- -----			1	SWITCH,ROTARY:(SEE S9891 REPL)		
					*************(ATTACHING PARTS)***********		
-105	210-0590-00			1	NUT,PLAIN,HEX.:0.375-32 X 0.438" BRS	73743	2X28269-402
-106	210-0978-00			1	WASHER,FLAT:0.375 ID X 0.50 INCH OD,STL	12327	ORD BY DESCR
					***********(END ATTACHING PARTS)*********		

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
1-107	195-0184-00			1	LEAD SET,ELEC:14.0 L,FRONT PANEL CONTROL	80009	195-0184-00
	----- -----			-	(1481, 1482 & 1485 ONLY)		
-108	352-0197-00			3	.CONN BODY,PL,EL:1 WIRE BLACK	80009	352-0197-00
-109	131-0621-00			3	.CONNECTOR,TERM:22-26 AWG,BRS & CU BE GOLD	22526	46231-000
-110	----- -----			1	RES.,VARIABLE:(SEE R9892,S9892 REPL)		
					**************(ATTACHING PARTS)************		
-111	210-0465-00			1	NUT,PLAIN,HEX.:0.25-32 X 0.375 INCH BRS	73743	3095-402
-112	210-0046-00			2	WASHER,LOCK:0.261 ID,INTL,0.018 THK,BRS	77900	1214-05-00-0541C
					************(END ATTACHING PARTS)*********		
-113	426-0474-00			1	MOUNT,RESILIENT:S SHAPE	80009	426-0474-00
					**************(ATTACHING PARTS)************		
-114	210-0406-00			2	NUT,PLAIN,HEX:4-40 X 0.188,BRS,CD PL	73743	12161-50
-115	210-0004-00			2	WASHER,LOCK:#4 INTL,0.015 THK,STL CD PL	77900	1204-00-000541C
					************(END ATTACHING PARTS)*********		
-116	----- -----			1	SWITCH,ROTARY:(SEE S9890 REPL)		
					**************(ATTACHING PARTS)************		
-117	210-0590-00			1	NUT,PLAIN,HEX.:0.375-32 X 0.438" BRS	73743	2X28269-402
-118	210-0978-00			1	WASHER,FLAT:0.375 ID X 0.50 INCH OD,STL	12327	ORD BY DESCR
					************(END ATTACHING PARTS)*********		
-119	----- -----			1	SWITCH,ROTARY:(SEE S9915 REPL)		
					**************(ATTACHING PARTS)************		
-120	210-0590-00			1	NUT,PLAIN,HEX.:0.375-32 X 0.438" BRS	73743	2X28269-402
-121	210-0978-00			1	WASHER,FLAT:0.375 ID X 0.50 INCH OD,STL	12327	ORD BY DESCR
					************(END ATTACHING PARTS)*********		
-122	----- -----			2	RES.,VARIABLE:(SEE R9935,R9940 REPL)		
-123	210-0046-00			2	WASHER,LOCK:0.261 ID,INTL,0.018 THK,BRS	77900	1214-05-00-0541C
-124	129-0582-00			2	SPACER,POST:0.67 LONG X W/0.25-32 THD	80009	129-0582-00
					**************(ATTACHING PARTS)************		
-125	358-0422-00	B060000	B063505	2	BSHG,MACH,THD:0.25-32 X 0.187" LONG BRS	80009	358-0422-00
	358-0409-00	B063506		2	BSHG,MACH,THD:0.25-32 X 0.159 ID X 0.24	80009	358-0409-00
					************(END ATTACHING PARTS)*********		
-126	----- -----			1	CKT BOARD ASSY:VERTICAL SWITCH		
	----- -----			-	(SEE A1 REPL)		
					**************(ATTACHING PARTS)************		
-127	211-0232-00	B060000	B062196	2	SCREW,MACHINE:4-40 X 0.25 INCH,FIL STL	83385	ORD BY DESCR
	211-0014-00	B062197		2	SCREW,MACHINE:4-40 X 0.50,PHN STL,POZ	83385	ORD BY DESCR
-128	211-0038-00			2	SCREW,MACHINE:4-40 X 0.312,FLH,100 DEG	83385	ORD BY DESCR
-129	129-0308-00			2	POST,ELEC-MECH:HEX.,0.25 X 0.465 INCH LONG	80009	129-0308-00
					************(END ATTACHING PARTS)*********		
	----- -----			-	CKT BOARD ASSY INCLUDES:		
-130	131-0589-00			28	.TERMINAL,PIN:0.46 L X 0.025 SQ	22526	48283-029
-131	----- -----			1	.SWITCH,PUSH:(SEE S2210,S2220,S2230,S2250,		
	----- -----			-	.S2255,S2270,S2280 REPL)		
	361-0969-00	B061750	B062196	2	.SPACER,SWITCH:0.2 X 0.13,AL	80009	361-0969-00
	361-0969-01	B062197	B073169	2	.SPACER,SWITCH:0.2 X 0.13,AL	80009	361-0969-01
	214-3145-00	B073170		1	.CLIP,SW RTNG:CU BE	80009	214-3145-00
	211-0061-00	B073170		1	.SCREW,MACHINE:4-40 X 0.50,FILH,STL,CD PL	83385	ORD BY DESCR
-132	361-0384-00	B060000	B064489	8	.SPACER,PB SW:0.133L,RED POLYCARBONATE	80009	361-0384-00
	361-0385-00	B064490		8	.SPACER,PB SW:0.164 INCH LONG	80009	361-0385-00
-133	----- -----			1	CKT BOARD ASSY:HORIZONTAL SWITCH		
	----- -----			-	(SEE A3 REPL)		
					**************(ATTACHING PARTS)************		
-134	211-0232-00	B060000	B062196	6	SCREW,MACHINE:4-40 X 0.25 INCH,FIL STL	83385	ORD BY DESCR
	211-0232-00	B062197		4	SCREW,MACHINE:4-40 X 0.25 INCH,FIL STL	83385	ORD BY DESCR
	211-0014-00	B062197	B073169	2	SCREW,MACHINE:4-40 X 0.50,PHN STL,POZ	83385	ORD BY DESCR
-135	211-0038-00			4	SCREW,MACHINE:4-40 X 0.312,FLH,100 DEG	83385	ORD BY DESCR
-136	129-0427-00			2	POST,ELEC-MECH:4-40 X 0.188 X 1.056" L HEX	80009	129-0427-00
-137	129-0308-00			2	POST,ELEC-MECH:HEX.,0.25 X 0.465 INCH LONG	80009	129-0308-00
					************(END ATTACHING PARTS)*********		
	----- -----			-	CKT BOARD ASSY INCLUDES:		
-138	131-0589-00			19	.TERMINAL,PIN:0.46 L X 0.025 SQ	22526	48283-029
-139	----- -----			1	.SWITCH,PUSH:(SEE S5001,S5041,S5071 REPL)		

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
1-140	----- -----			1	.SWITCH,PUSH:(SEE S5006,S5016,S5026,S5036,		
	----- -----			-	.S5056,S5076,S5086,S5096 REPL)		
-141	361-0384-00	B060000	B061551	14	.SPACER,PB SW:0.133L,RED POLYCARBONATE	80009	361-0384-00
	361-0385-00	B061552		14	.SPACER,PB SW:0.164 INCH LONG	80009	361-0385-00
	361-0969-00	B061750	B062196	2	.SPACER,SWITCH:0.2 X 0.13,AL	80009	361-0969-00
	361-0969-01	B062197	B073169	2	.SPACER,SWITCH:0.2 X 0.13,AL	80009	361-0969-01
	214-3145-00	B073170		1	.CLIP,SW RTNG:CU BE	80009	214-3145-00
	211-0061-00	B073170		1	.SCREW,MACHINE:4-40 X 0.50,FILH,STL,CD PL	83385	ORD BY DESCR
-142	384-1136-00			6	.EXTENSION SHAFT:0.95 INCH LONG	80009	384-1136-00


A1
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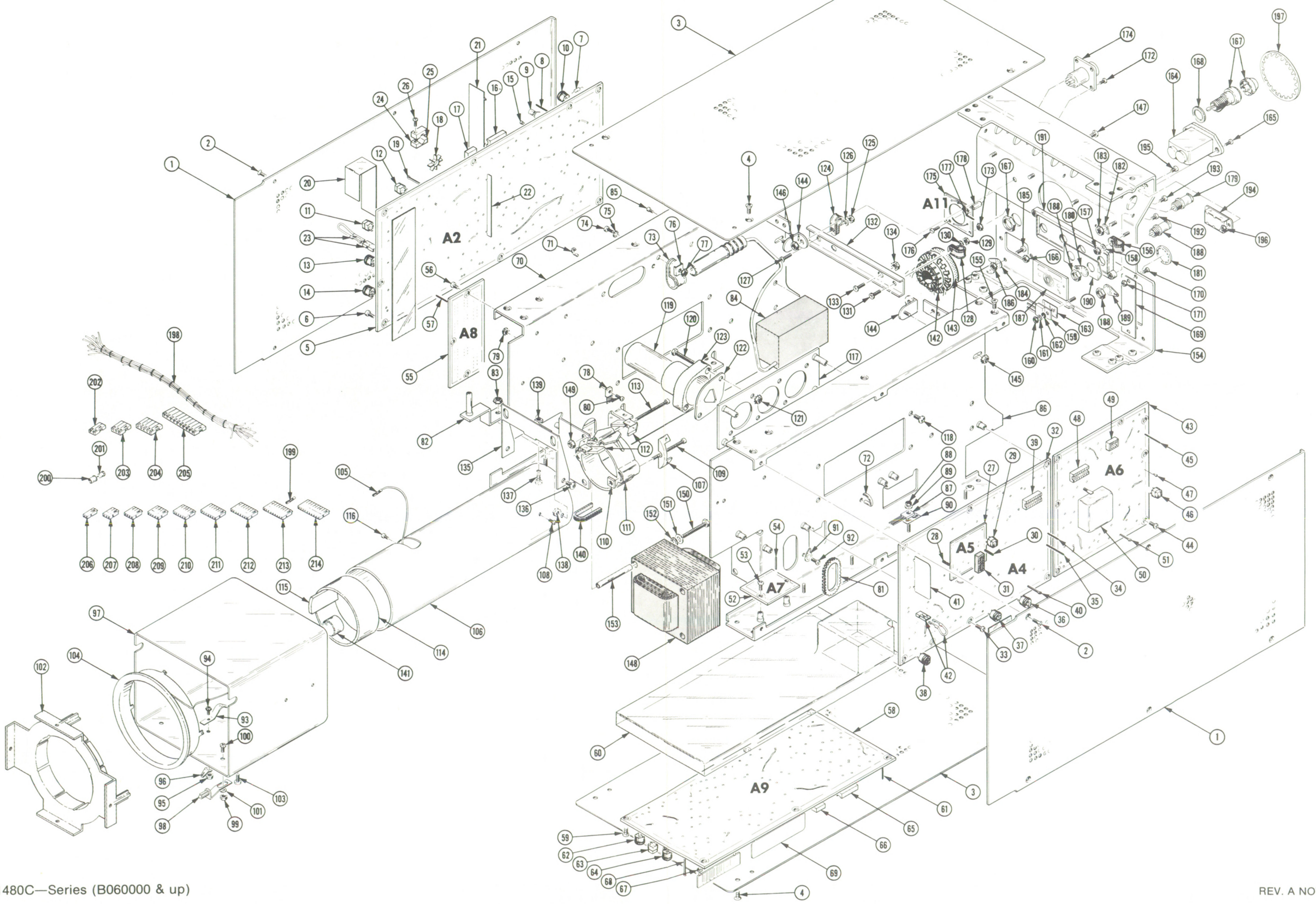
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Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
2-1	390-0436-00			2	COVER,MONITOR:MONITOR	80009	390-0436-00
					*************(ATTACHING PARTS)***********		
-2	211-0101-00			12	SCREW,MACHINE:4-40 X 0.25,FLH,100 DEG,STL	83385	ORD BY DESCR
					***********(END ATTACHING PARTS)*********		
-3	390-0437-00			2	COVER,MONITOR:MONITOR	80009	390-0437-00
					*************(ATTACHING PARTS)***********		
-4	212-0070-00			8	SCREW,MACHINE:8-32 X 0.312¯100 DEG,FLH ST	T0435	ORD BY DESCR
					***********(END ATTACHING PARTS)*********		
-5	----- -----			1	CKT BOARD ASSY:VERTICAL AMPLIFITER		
	----- -----			-	(SEE A2 REPL)		
					*************(ATTACHING PARTS)***********		
-6	211-0007-00			6	SCREW,MACHINE:4-40 X 0.188,PNH STL,CD PL	83385	ORD BY DESCR
					***********(END ATTACHING PARTS)*********		
	----- -----			-	CKT BOARD ASSY INCLUDES:		
-7	131-0566-00			2	.BUS CONDUCTOR:DUMMY RES,2.375,22 AWG	57668	JWW-0200E0
-8	131-0589-00			72	.TERMINAL,PIN:0.46 L X 0.025 SQ	22526	48283-029
	131-0608-00			6	.TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD	22526	48283-036
-9	131-1003-00			3	.CONN,RCPT,ELEC:CKT BD MT,3 PRONG	80009	131-1003-00
-10	136-0183-00			2	.SOCKET,PLUG-IN:3 PIN,ROUND	80009	136-0183-00
-11	136-0219-00			3	.SOCKET,PLUG-IN:4 PIN	80009	136-0219-00
-12	136-0220-00	B060000	B062663	57	.SKT,PL-IN ELEK:TRANSISTOR 3 CONTACT,PCB M	71785	133-23-11-034
	136-0220-00	B062664		32	.SKT,PL-IN ELEK:TRANSISTOR 3 CONTACT,PCB M	71785	133-23-11-034
-13	136-0235-00			2	.SOCKET,PLUG-IN:6 CONTACT,ROUND	71785	133-96-12-062
-14	136-0237-00			1	.SOCKET,PLUG-IN:8 CONTACT,ROUND	71785	133-98-12-062
-15	136-0252-07			9	.SOCKET,PIN CONN:W/O DIMPLE	22526	75060-012
	136-0352-00			40	.CONTACT,ELEC:FOR 0.02 INCH DIAMETER PIN	00779	50462-7
-16	136-0260-02			2	.SKT,PL-IN ELEK:MICROCIRCUIT,16 DIP,LOW CL	09922	DILB16P-108T
-17	136-0514-00			2	.SKT,PL-IN ELEC:MICROCIRCUIT,8 DIP	09922	DILB8P-108
-18	214-1292-00			2	.HEAT SINK,ELEC:TRANSISTOR	05820	205SB
-19	214-0579-00			6	.TERM,TEST POINT:BRS CD PL	80009	214-0579-00
-20	337-0950-00			1	.SHIELD,ELEC:CIRCUIT BOARD	80009	337-0950-00
-21	337-1456-00			1	.SHLD,ELECTRICAL:CKT BOARD MOUNT	80009	337-1456-00
-22	337-2068-00			1	.SHIELD,ELEC:CKT BOARD MOUNT	80009	337-2068-00
-23	131-0993-00			1	.BUS,CONDUCTOR:2 WIRE BLACK	00779	850100-01
	198-3171-00			1	.WIRE SET,ELEC:	80009	198-3171-00
-24	200-0945-00			5	.COVER,HALF XSTR:DUAL TO-18,ALUMINUM	80009	200-0945-00
-25	200-0945-01			5	.COVER,HALF XSTR:DUAL TO-18,W/2-56 THD	80009	200-0945-01
					.***********(ATTACHING PARTS)***********		
-26	211-0001-00			5	.SCREW,MACHINE:2-56 X 0.25 INCH,PNH STL	87308	ORD BY DESCR
					.*********(END ATTACHING PARTS)*********		
-27	----- -----			1	CKT BOARD ASSY:PAL-M LINE COUNTER		
	----- -----			-	(SEE A5 REPL)		
-28	136-0327-01			9	.SOCKET,PIN TERM:0.067 INCH DIA	00779	86281-2
-29	136-0220-00			1	.SKT,PL-IN ELEK:TRANSISTOR 3 CONTACT,PCB M	71785	133-23-11-034
-30	131-0608-00			6	.TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD	22526	48283-036
-31	136-0269-02			2	.SKT,PL-IN ELEK:MICROCIRCUIT,14 DIP	09922	DILB14P-108T
-32	----- -----			1	CKT BOARD ASSY:SWEEP OUTPUT(SEE A4 REPL)		
					*************(ATTACHING PARTS)***********		
-33	211-0007-00			7	SCREW,MACHINE:4-40 X 0.188,PNH STL,CD PL	83385	ORD BY DESCR
					***********(END ATTACHING PARTS)*********		
	----- -----			-	CKT BOARD ASSY INCLUDES:		
-34	131-0589-00			94	.TERMINAL,PIN:0.46 L X 0.025 SQ	22526	48283-029
	131-0608-00			30	.TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD	22526	48283-036
-35	131-0787-00			9	.TERMINAL,PIN:0.64LX0.025SQ PH BRZ,GOLD	22526	47359-000
-36	136-0183-00			4	.SOCKET,PLUG-IN:3 PIN,ROUND	80009	136-0183-00
	136-0220-00	B060000	B062663	34	.SKT,PL-IN ELEK:TRANSISTOR 3 CONTACT,PCB M	71785	133-23-11-034
	136-0220-00	B062664		14	.SKT,PL-IN ELEK:TRANSISTOR 3 CONTACT,PCB M	71785	133-23-11-034
-37	136-0235-00			2	.SOCKET,PLUG-IN:6 CONTACT,ROUND	71785	133-96-12-062
-38	136-0241-00			2	.SKT,PL-IN ELEK:MICROCIRCUIT,10 CONT,PCB M	71785	133-99-12-064
-39	136-0260-02			1	.SKT,PL-IN ELEK:MICROCIRCUIT,16 DIP,LOW CL	09922	DILB16P-108T
	136-0269-02			21	.SKT,PL-IN ELEK:MICROCIRCUIT,14 DIP	09922	DILB14P-108T
-40	214-0579-00			10	.TERM,TEST POINT:BRS CD PL	80009	214-0579-00
-41	337-2258-00			1	.SHIELD,ELEC:CIRCUIT BOARD	80009	337-2258-00
-42	131-0993-00			7	.BUS,CONDUCTOR:2 WIRE BLACK	00779	850100-01

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
2-43	----- -----			1	CKT BOARD ASSY:SYNC & TIMING		
	----- -----			-	(SEE A6 REPL)		
					*************(ATTACHING PARTS)***********		
-44	211-0007-00			4	SCREW,MACHINE:4-40 X 0.188,PNH STL,CD PL	83385	ORD BY DESCR
					***********(END ATTACHING PARTS)*********		
	----- -----			-	CKT BOARD ASSY INCLUDES:		
-45	131-0589-00			36	.TERMINAL,PIN:0.46 L X 0.025 SQ	22526	48283-029
	131-0608-00			4	.TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD	22526	48283-036
-46	136-0220-00	B060000	B062663	35	.SKT,PL-IN ELEK:TRANSISTOR 3 CONTACT,PCB M	71785	133-23-11-034
	136-0220-00	B062664		3	.SKT,PL-IN ELEK:TRANSISTOR 3 CONTACT,PCB M	71785	133-23-11-034
-47	136-0252-07			3	.SOCKET,PIN CONN:W/O DIMPLE	22526	75060-012
-48	136-0260-02			2	.SKT,PL-IN ELEK:MICROCIRCUIT,16 DIP,LOW CL	09922	DILB16P-108T
-49	136-0514-00			3	.SKT,PL-IN ELEC:MICROCIRCUIT,8 DIP	09922	DILB8P-108
-50	202-0196-01			1	.CAN,ALUMINUM:1.25 X 0.80 X 0.02 INCH THK	0000G	ORD BY DESCR
-51	214-0579-00			14	.TERM,TEST POINT:BRS CD PL	80009	214-0579-00
-52	----- -----			1	CKT BOARD ASSY:FRONT PANEL CONNECTOR		
	----- -----			-	(SEE A7 REPL)		
					*************(ATTACHING PARTS)***********		
-53	211-0007-00			2	SCREW,MACHINE:4-40 X 0.188,PNH STL,CD PL	83385	ORD BY DESCR
					***********(END ATTACHING PARTS)*********		
	----- -----			-	CKT BOARD ASSY INCLUDES:		
-54	131-0608-00			60	.TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD	22526	48283-036
-55	----- -----			1	CKT BOARD ASSY:FRONT PANEL CONNECTOR		
	----- -----			-	(SEE A8 REPL)		
					*************(ATTACHING PARTS)***********		
-56	211-0007-00			3	SCREW,MACHINE:4-40 X 0.188,PNH STL,CD PL	83385	ORD BY DESCR
					***********(END ATTACHING PARTS)*********		
	----- -----			-	CKT BOARD ASSY INCLUDES:		
-57	131-0608-00			160	.TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD	22526	48283-036
-58	----- -----			1	CKT BOARD ASSY:POWER SUPPLY(SEE A9 REPL)		
					*************(ATTACHING PARTS)***********		
-59	211-0007-00			6	SCREW,MACHINE:4-40 X 0.188,PNH STL,CD PL	83385	ORD BY DESCR
-60	337-1997-01			1	SHIELD,ELEC:HV CKT BOARD	80009	337-1997-01
					***********(END ATTACHING PARTS)*********		
	----- -----			-	CKT BOARD ASSY INCLUDES:		
-61	131-0589-00			85	.TERMINAL,PIN:0.46 L X 0.025 SQ	22526	48283-029
-62	136-0183-00	B060000	B062663	8	.SOCKET,PLUG-IN:3 PIN,ROUND	80009	136-0183-00
	136-0183-00	B062664		2	.SOCKET,PLUG-IN:3 PIN,ROUND	80009	136-0183-00
-63	136-0220-00	B060000	B062663	5	.SKT,PL-IN ELEK:TRANSISTOR 3 CONTACT,PCB M	71785	133-23-11-034
	136-0220-00	B062664		3	.SKT,PL-IN ELEK:TRANSISTOR 3 CONTACT,PCB M	71785	133-23-11-034
-64	136-0235-00			1	.SOCKET,PLUG-IN:6 CONTACT,ROUND	71785	133-96-12-062
-65	136-0269-02			3	.SKT,PL-IN ELEK:MICROCIRCUIT,14 DIP	09922	DILB14P-108T
-66	136-0514-00			1	.SKT,PL-IN ELEC:MICROCIRCUIT,8 DIP	09922	DILB8P-108
-67	166-0292-00	B060000	B073291	3	.SPACER,SLEEVE:PLSTC,0.155 DIA X 0.065"L	80009	166-0292-00
	----- -----			-	.(1480C ONLY)		
	166-0292-00	B060000	B080368	3	.SPACER,SLEEVE:PLSTC,0.155 DIA X 0.065"L	80009	166-0292-00
	----- -----			-	.(1480R ONLY)		
	166-0292-00	B060000	B073384	3	.SPACER,SLEEVE:PLSTC,0.155 DIA X 0.065"L	80009	166-0292-00
	----- -----			-	.(1481C ONLY)		
	166-0292-00	B060000	B080369	3	.SPACER,SLEEVE:PLSTC,0.155 DIA X 0.065"L	80009	166-0292-00
	----- -----			-	.(1481R ONLY)		
	166-0292-00	B060000	B080358	3	.SPACER,SLEEVE:PLSTC,0.155 DIA X 0.065"L	80009	166-0292-00
	----- -----			-	.(1482R ONLY)		
	166-0292-00	B060000	B073367	3	.SPACER,SLEEVE:PLSTC,0.155 DIA X 0.065"L	80009	166-0292-00
	----- -----			-	.(1485R ONLY)		
	166-0292-00	B060000	B080377	3	.SPACER,SLEEVE:PLSTC,0.155 DIA X 0.065"L	80009	166-0292-00
	----- -----			-	.(1485R ONLY)		
-68	214-0579-00			9	.TERM,TEST POINT:BRS CD PL	80009	214-0579-00
-69	337-1456-00			1	.SHLD,ELECTRICAL:CKT BOARD MOUNT	80009	337-1456-00
-70	441-1255-00	B060000	B063505	1	CHAS,ELEC EQPT:VERTICAL	80009	441-1255-00
	441-1255-01	B063506	B084029	1	CHASSIS,MONITOR:VERTICAL	80009	441-1255-01
	441-1255-02	B084030		1	CHASSIS,MONITOR:VERTICAL	80009	441-1255-02
-71	343-0088-00			3	CLAMP,LOOP:0.062 INCH DIA	80009	343-0088-00

Fig. & Index No.	Tektronix Part No.	Serial/Model No.		Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
		Eff	Dscont				
2-72	343-0089-00			2	CLAMP,LOOP:LARGE	80009	343-0089-00
-73	343-0006-00			1	CLAMP,LOOP:0.50 INCH DIAMETER,PLSTC	95987	1-2-6B
					*************(ATTACHING PARTS)***********		
-74	211-0510-00			1	SCREW,MACHINE:6-32 X 0.375,PNH,STL,CD PL	83385	ORD BY DESCR
-75	210-0006-00			1	WASHER,LOCK:#6 INTL,0.018 THK,STL CD PL	77900	1206-00-00-0541C
-76	210-0863-00			1	WSHR,LOOP CLAMP:0.187 ID U/W 0.5 W CLP,STL	95987	C191
-77	210-0457-00			1	NUT,PL,ASSEM WA:6-32 X 0.312,STL CD PL	83385	ORD BY DESCR
					***********(END ATTACHING PARTS)*********		
-78	156-0277-00			1	MICROCIRCUIT,LI:VOLTAGE REGULATOR	07263	MICROA7805UC
					*************(ATTACHING PARTS)***********		
-79	210-0586-00			1	NUT,PL,ASSEM WA:4-40 X 0.25,STL CD PL	T0435	ORD BY DESCR
-80	211-0033-00			1	SCR,ASSEM WSHR:4-40 X 0.312 PNH,STL,CD PL	83385	ORD BY DESCR
					***********(END ATTACHING PARTS)*********		
-81	255-0334-00			FT	PLASTIC CHANNEL:12.75 X 0.175 X 0.155,NYL	11897	122-37-2500
-82	407-1579-00			1	BRACKET,ELEC SW:ALUMINUM	80009	407-1579-00
					*************(ATTACHING PARTS)***********		
-83	210-0458-00			1	NUT,PL,ASSEM WA:8-32 X 0.344,STL,CD PL	78189	511-081800-00
					***********(END ATTACHING PARTS)*********		
-84	----- -----			1	MULTIPLIER:(SEE U9240 REPL)		
					*************(ATTACHING PARTS)***********		
-85	211-0033-00			3	SCR,ASSEM WSHR:4-40 X 0.312 PNH,STL,CD PL	83385	ORD BY DESCR
					***********(END ATTACHING PARTS)*********		
-86	441-1256-00	B060000	B063505	1	CHAS,ELEC EQPT:HORIZONTAL	80009	441-1256-00
	441-1256-02	B063506		1	CHASSIS,MONITOR:HORIZONTAL	80009	441-1256-02
-87	----- -----			4	TRANSISTOR:		
	----- -----			-	(SEE Q9200,Q9300,Q9500,Q9600 REPL)		
					*************(ATTACHING PARTS)***********		
-88	210-0406-00			4	NUT,PLAIN,HEX:4-40 X 0.188,BRS,CD PL	73743	12161-50
-89	210-1122-00			4	WASHER,LOCK:0.12 ID,DISHED,0.025 THK	86928	ORD BY DESCR
-90	342-0163-00			4	INSULR,PLATE:XSTR,0.675 X 0.625 X 0.001"	80009	342-0163-00
					***********(END ATTACHING PARTS)*********		
-91	210-0201-00			2	TERMINAL,LUG:0.12 ID,LOCKING,BRZ TIN PL	86928	A373-157-2
					*************(ATTACHING PARTS)***********		
-92	213-0088-00			2	SCR,TPG,THD CTG:4-24 X 0.25 INCH,PNH STL	83385	ORD BY DESCR
					***********(END ATTACHING PARTS)*********		
-93	214-0291-00			1	CONTACT,SPRING:1.188 X 0.375 X 0.25 INCH	80009	214-0291-00
					*************(ATTACHING PARTS)***********		
-94	211-0033-00			1	SCR,ASSEM WSHR:4-40 X 0.312 PNH,STL,CD PL	83385	ORD BY DESCR
-95	210-0586-00			1	NUT,PL,ASSEM WA:4-40 X 0.25,STL CD PL	T0435	ORD BY DESCR
-96	210-0201-00			1	TERMINAL,LUG:0.12 ID,LOCKING,BRZ TIN PL	86928	A373-157-2
					***********(END ATTACHING PARTS)*********		
-97	337-1643-01	B060000	B061503	1	SHIELD SECT,CRT:REAR	80009	337-1643-01
	337-1643-02	B061504		1	SHIELD,ELEC:	80009	337-1643-02
-98	136-0273-00			2	LAMPHOLDER:FOR GROOVED BASE	95263	25-06XP11A
					*************(ATTACHING PARTS)***********		
-99	210-0586-00			2	NUT,PL,ASSEM WA:4-40 X 0.25,STL CD PL	T0435	ORD BY DESCR
-100	211-0033-00			2	SCR,ASSEM WSHR:4-40 X 0.312 PNH,STL,CD PL	83385	ORD BY DESCR
-101	210-0994-00			2	WASHER,FLAT:0.125 ID X 0.25" OD,STL	86928	5702-201-20
					***********(END ATTACHING PARTS)*********		
-102	386-2876-01			1	SUPPORT,CRT:CENTER	80009	386-2876-01
					*************(ATTACHING PARTS)***********		
-103	213-0104-00			4	SCR,TPG,THD FOR:6-20 X 0.375 INCH,TRH STL	83385	ORD BY DESCR
					***********(END ATTACHING PARTS)*********		
-104	----- -----			1	COIL:TRACE LOCATION(SEE L9650 REPL)		
-105	198-2381-00	B060000	B073704	1	WIRE SET,ELEC:	80009	198-2381-00
	198-2381-02	B073705		1	WIRE SET,ELEC:(1480C ONLY)	80009	198-2381-02
	198-2381-00	B060000	B082063	1	WIRE SET,ELEC:	80009	198-2381-00
	198-2381-02	B082064		1	WIRE SET,ELEC:(1480R ONLY)	80009	198-2381-02
	198-2381-00	B060000	B073704	1	WIRE SET,ELEC:	80009	198-2381-00
	198-2381-02	B073705		1	WIRE SET,ELEC:(1481C ONLY)	80009	198-2381-02
	198-2381-00	B060000	B082044	1	WIRE SET,ELEC:	80009	198-2381-00
	198-2381-02	B082045		1	WIRE SET,ELEC:(1481R ONLY)	80009	198-2381-02

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
2-	198-2381-00	B060000	B073442	1	WIRE SET,ELEC:	80009	198-2381-00
	198-2381-02	B073443		1	WIRE SET,ELEC:(1482C ONLY)	80009	198-2381-02
	198-2381-00	B060000	B082230	1	WIRE SET,ELEC:	80009	198-2381-00
	198-2381-02	B082231		1	WIRE SET,ELEC:(1482R ONLY)	80009	198-2381-02
	198-2381-00	B060000	B073711	1	WIRE SET,ELEC:	80009	198-2381-00
	198-2381-02	B073712		1	WIRE SET,ELEC:(1485C ONLY)	80009	198-2381-02
	198-2381-00	B060000	B082046	1	WIRE SET,ELEC:	80009	198-2381-00
	198-2381-02	B082047		1	WIRE SET,ELEC:(1485R ONLY)	80009	198-2381-02
-106	337-2055-00	B060000	B061503	1	SHIELD SECT,CRT:REAR	80009	337-2055-00
	337-2055-01	B061504		1	SHIELD SECT,CRT:REAR	80009	337-2055-01
-107	352-0091-01			2	RTNR,LOOP CLAMP:ELECTRON TUBE	80009	352-0091-01
					**************(ATTACHING PARTS)***********		
-108	211-0590-00			4	SCREW,MACHINE:6-32 X 0.25Q,PNH,BRS,CD PL	83385	ORD BY DESCR
-109	211-0599-00			2	SCREW,MACHINE:6-32 X 0.750 INCH,FIL SST	83385	ORD BY DESCR
-110	220-0444-00			2	NUT,PLAIN,SQ:6-32 X 0.250 INCH,STL	70318	ORD BY DESCR
					***********(END ATTACHING PARTS)*********		
-111	343-0124-00			1	CLAMP,LOOP:ELECTRON TUBE RETAINER	80009	343-0124-00
-112	343-0123-03			1	CLP,ELCTRN TUBE:AL,CD PL	80009	343-0123-03
					**************(ATTACHING PARTS)***********		
-113	211-0600-00			1	SCREW,MACHINE:6-32 X 2 INCH,FIL SST	83385	ORD BY DESCR
					***********(END ATTACHING PARTS)*********		
-114	----- -----			1	COIL:Y-AXIS(SEE L9350 REPL)		
-115	343-0217-00			1	CLAMP,COIL:Y-AXIS	80009	343-0217-00
					**************(ATTACHING PARTS)***********		
-116	211-0007-00			2	SCREW,MACHINE:4-40 X 0.188,PNH STL,CD PL	83385	ORD BY DESCR
					***********(END ATTACHING PARTS)*********		
-117	407-1547-00			1	BRACKET,ANGLE:CAPACITOR	80009	407-1547-00
					**************(ATTACHING PARTS)***********		
-118	211-0542-00			4	SCREW,MACHINE:6-32 X 0.312 INCH,TRH STL	83385	ORD BY DESCR
					***********(END ATTACHING PARTS)*********		
-119	----- -----			3	CAPACITOR:(SEE C9510,C9520,C9530 REPL)		
					**************(ATTACHING PARTS)***********		
-120	211-0588-00			2	SCREW,MACHINE:6-32 X 0.75 INCH,HEX.HD STL	83385	ORD BY DESCR
-121	210-0457-00			2	NUT,PL,ASSEM WA:6-32 X 0.312,STL CD PL	83385	ORD BY DESCR
-122	386-0252-00			1	RETAINER,CAP.:SMALL FIBER	85703	ORD BY DESCR
-123	432-0047-00			1	BASE,CAP.MTG:	80009	432-0047-00
					***********(END ATTACHING PARTS)*********		
-124	343-0003-00			1	CLAMP,LOOP:0.25 ID,PLASTIC	95987	1-4-6B
					**************(ATTACHING PARTS)***********		
-125	210-0457-00			1	NUT,PL,ASSEM WA:6-32 X 0.312,STL CD PL	83385	ORD BY DESCR
-126	210-0803-00			1	WASHER,FLAT:0.15 ID X 0.032 THK,STL CD	12327	ORD BY DESCR
-127	211-0540-00			1	SCREW,MACHINE:6-32 X 0.50 INCH,TRH STL	83385	ORD BY DESCR
					***********(END ATTACHING PARTS)*********		
-128	343-0002-00			1	CLAMP,LOOP:0.188 INCH DIA	95987	3-16-6B
					**************(ATTACHING PARTS)***********		
-129	210-0457-00			1	NUT,PL,ASSEM WA:6-32 X 0.312,STL CD PL	83385	ORD BY DESCR
-130	210-0803-00			1	WASHER,FLAT:0.15 ID X 0.032 THK,STL CD	12327	ORD BY DESCR
-131	211-0540-00			1	SCREW,MACHINE:6-32 X 0.50 INCH,TRH STL	83385	ORD BY DESCR
					***********(END ATTACHING PARTS)*********		
-132	386-3267-00			1	SUPPORT,CHASSIS:REAR	80009	386-3267-00
					**************(ATTACHING PARTS)***********		
-133	211-0540-00			2	SCREW,MACHINE:6-32 X 0.50 INCH,TRH STL	83385	ORD BY DESCR
-134	210-0457-00			2	NUT,PL,ASSEM WA:6-32 X 0.312,STL CD PL	83385	ORD BY DESCR
					***********(END ATTACHING PARTS)*********		
-135	407-1651-00			1	BRKT,CRT SHIELD:REAR,ALUMINUM	80009	407-1651-00
					**************(ATTACHING PARTS)***********		
-136	211-0534-00			3	SCR,ASSEM,WSHR:6-32 X 0.312 INCH,PNH STL	83385	ORD BY DESCR
-137	211-0540-00			2	SCREW,MACHINE:6-32 X 0.50 INCH,TRH STL	83385	ORD BY DESCR
-138	210-0457-00			5	NUT,PL,ASSEM WA:6-32 X 0.312,STL CD PL	83385	ORD BY DESCR
-139	220-0419-00			1	NUT,PLAIN,SQ:6-32 X 0.312 INCH,STL	83385	ORD BY DESCR
					***********(END ATTACHING PARTS)*********		
-140	348-0085-00	B060000	B061503	1	GROMMET,PLASTIC:GRAY,U-SHAPED,0.48 ID	80009	348-0085-00
	348-0532-00	B061504		1	GROMMET,PLASTIC:BLACK,ROUND,0.625 ID	28520	SB-750-10

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
2-141	348-0064-00			1	GROMMET,PLASTIC:GRAY,ROUND,0.582 ID	80009	348-0064-00
-142	136-0607-00			1	SKT PL-IN ELEK:ELCTRN TUBE,14 CONT W/LEADS	80009	136-0607-00
-143	200-0616-00			1	COVER,CRT SKT:1.78 DIA X 0.2 D,WHITE	80009	200-0616-00
-144	407-0983-00			2	BRACKET,ANGLE:CRT SHIELD,ALUMINUM	80009	407-0983-00
					*************(ATTACHING PARTS)**********		
-145	210-0458-00			2	NUT,PL,ASSEM WA:8-32 X 0.344,STL,CD PL	78189	511-081800-00
-146	210-0457-00			2	NUT,PL,ASSEM WA:6-32 X 0.312,STL CD PL	83385	ORD BY DESCR
-147	211-0542-00			2	SCREW,MACHINE:6-32 X 0.312 INCH,TRH STL	83385	ORD BY DESCR
					***********(END ATTACHING PARTS)*********		
-148	----- -----			1	TRANSFORMER:(SEE T9400 REPL)		
					*************(ATTACHING PARTS)**********		
-149	220-0410-00			4	NUT,EXTENDED WA:10-32 X 0.375 INCH,STL	83385	ORD BY DESCR
-150	212-0515-00			4	SCREW,MACHINE:10-32 X 2.250" HEX.HD STL	83385	ORD BY DESCR
-151	210-0805-00			4	WASHER,FLAT:0.204 ID X 0.438 INCH OD	12327	ORD BY DESCR
-152	210-0812-00			4	WASHER,NONMETAL:#10,FIBER	86445	ORD BY DESCR
-153	166-0227-00			4	INS SLV,ELEC:0.187 ID X 1.50 INCH LONG	80009	166-0227-00
					***********(END ATTACHING PARTS)*********		
-154	386-3082-00			1	PANEL,REAR:	80009	386-3082-00
					*************(ATTACHING PARTS)**********		
-155	211-0538-00			8	SCREW,MACHINE:6-32 X 0.312"100 DEG,FLH	83385	ORD BY DESCR
					***********(END ATTACHING PARTS)*********		
-156	343-0002-00			1	CLAMP,LOOP:0.188 INCH DIA	95987	3-16-6B
					*************(ATTACHING PARTS)**********		
-157	210-0457-00			1	NUT,PL,ASSEM WA:6-32 X 0.312,STL CD PL	83385	ORD BY DESCR
-158	210-0803-00			1	WASHER,FLAT:0.15 ID X 0.032 THK,STL CD	12327	ORD BY DESCR
					***********(END ATTACHING PARTS)*********		
-159	----- -----			1	TRANSISTOR:(SEE Q9180 REPL)		
					*************(ATTACHING PARTS)**********		
-160	210-0586-00			1	NUT,PL,ASSEM WA:4-40 X 0.25,STL CD PL	T0435	ORD BY DESCR
-161	210-1171-00	B060000	B061449	1	WSHR,SHOULDERED:0.116 ID X 0.138 INCH OD	52905	A7148516P2
	210-1178-00	B061450		1	WASHER,SHLDR:U/W T0-220 TRANSISTOR	49671	DF 137A
-162	210-0994-00			1	WASHER,FLAT:0.125 ID X 0.25" OD,STL	86928	5702-201-20
-163	342-0203-00			1	INSULATOR,PLATE:XSTR,0.675 X 0.625 X 0.001	18722	DF103C
					***********(END ATTACHING PARTS)*********		
-164	----- -----			1	LINE FILTER:(SEE FL9190 REPL)		
					*************(ATTACHING PARTS)**********		
-165	211-0012-00			2	SCREW,MACHINE:4-40 X 0.375,PNH STL CD PL	83385	ORD BY DESCR
-166	210-0586-00			2	NUT,PL,ASSEM WA:4-40 X 0.25,STL CD PL	T0435	ORD BY DESCR
					***********(END ATTACHING PARTS)*********		
	200-1388-01	B060000	B061448	1	COVER,FUSE:	80009	200-1388-01
	200-0237-03	B061449	B061778	1	COVER,FUSE HLDR:	80009	200-0237-03
	200-0237-04	B061799		1	COVER,FUSE HLDR:PLASTIC,SAFETY CONTROLLED	80009	200-0237-04
-167	352-0362-01	B060000	B061654	1	FUSEHOLDER:W/HARDWARE	75915	345613
	204-0833-00	B061655		1	BODY,FUSEHOLDER:3AG & 5 X 20MM FUSES	S3629	031.1653(MDLFEU)
					*************(ATTACHING PARTS)**********		
-168	210-0873-00			1	WASHER,NONMETAL:0.5 ID X 0.688 INCH OD,NPR	70485	ORD BY DESCR
					***********(END ATTACHING PARTS)*********		
-169	200-0817-01			1	COVER,CONN MTG:2.812 X 0.75 AL	80009	200-0817-01
					*************(ATTACHING PARTS)**********		
-170	211-0097-00			2	SCREW,MACHINE:4-40 X 0.312 INCH,PNH STL	83385	ORD BY DESCR
-171	210-0586-00			2	NUT,PL,ASSEM WA:4-40 X 0.25,STL CD PL	T0435	ORD BY DESCR
					***********(END ATTACHING PARTS)*********		
	672-0724-00			1	CKT BOARD ASSY:CONNECTOR	80009	672-0724-00
					*************(ATTACHING PARTS)**********		
-172	211-0038-00			4	SCREW,MACHINE:4-40 X 0.312,FLH,100 DEG	83385	ORD BY DESCR
-173	210-0586-00			2	NUT,PL,ASSEM WA:4-40 X 0.25,STL CD PL	T0435	ORD BY DESCR
					***********(END ATTACHING PARTS)*********		
	----- -----			-	CKT BOARD ASSY INCLUDES:		
-174	136-0089-00			1	.CONNECTOR,RCPT:9 PIN CHASSIS MOUNT	02660	165-16
-175	----- -----			1	.CKT BOARD ASSY:CONNECTOR(SEE A11 REPL)		
					.***********(ATTACHING PARTS)***********		
-176	211-0007-00			2	.SCREW,MACHINE:4-40 X 0.188,PNH STL,CD PL	83385	ORD BY DESCR
					.*********(END ATTACHING PARTS)*********		
	----- -----			-	.CKT BOARD ASSY INCLUDES:		
-177	131-0589-00			9	..TERMINAL,PIN:0.46 L X 0.025 SQ	22526	48283-029

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
2-178	129-0353-00			2	POST,ELEC-MECH:0.188 HEX X 0.385 INCH LONG	80009	129-0353-00
-179	131-0955-00			5	CONN,RCPT,ELEC:BNC,FEMALE	13511	31-279
					**************(ATTACHING PARTS)***********		
-180	210-0255-00			5	TERMINAL,LUG:0.391 ID,LOCKING,BRS CD PL	80009	210-0255-00
					***********(END ATTACHING PARTS)*********		
-181	134-0138-00			2	BUTTON,PLUG:SNAP-IN	77132	SS48172
-182	210-0202-00			4	TERMINAL,LUG:0.146 ID,LOCKING,BRZ,TIN PL	78189	2104-06-00-2520N
					**************(ATTACHING PARTS)***********		
-183	210-0457-00			4	NUT,PL,ASSEM WA:6-32 X 0.312,STL CD PL	83385	ORD BY DESCR
					***********(END ATTACHING PARTS)*********		
-184	210-0205-00			1	TERMINAL,LUG:4-40 X 0.42,RDH,SST,RLV SHK	86928	5442-7
					**************(ATTACHING PARTS)***********		
-185	212-0004-00	B060000	B061654	1	SCREW,MACHINE:8-32 X 0.312 INCH,PNH STL	83385	ORD BY DESCR
	212-0008-00	B061655		1	SCREW,MACHINE:8-32 X 0.500 INCH,PNH STL	83385	ORD BY DESCR
-186	210-0458-00	B060000	B061654	1	NUT,PL,ASSEM WA:8-32 X 0.344,STL,CD PL	78189	511-081800-00
	210-0409-00	B061655		1	NUT,PLAIN,HEX.:8-32 X 0.312 INCH,BRS	73743	3046-402
					***********(END ATTACHING PARTS)*********		
-187	388-4026-00			4	CIRCUIT BOARD:LOOP THRU COMP	80009	388-4026-00
-188	131-0955-00			8	CONN,RCPT,ELEC:BNC,FEMALE	13511	31-279
					**************(ATTACHING PARTS)***********		
-189	210-0255-00			4	TERMINAL,LUG:0.391 ID,LOCKING,BRS CD PL	80009	210-0255-00
-190	346-0118-00			4	STRAP,GROUNDING:BNC	80009	346-0118-00
					***********(END ATTACHING PARTS)*********		
-191	386-3080-00			2	PLATE,CONN MTG:DELRIN	80009	386-3080-00
					**************(ATTACHING PARTS)***********		
-192	211-0097-00			6	SCREW,MACHINE:4-40 X 0.312 INCH,PNH STL	83385	ORD BY DESCR
-193	213-0054-00			2	SCR,TPG,THD FOR:6-32 X 0.312 INCH,PNH STL	93907	ORD BY DESCR
					***********(END ATTACHING PARTS)*********		
-194	----- -----			1	SWITCH,SLIDE:(SEE S9190)		
					**************(ATTACHING PARTS)***********		
-195	211-0097-00			2	SCREW,MACHINE:4-40 X 0.312 INCH,PNH STL	83385	ORD BY DESCR
-196	210-0586-00			2	NUT,PL,ASSEM WA:4-40 X 0.25,STL CD PL	T0435	ORD BY DESCR
					***********(END ATTACHING PARTS)*********		
-197	214-2175-00			1	BUTTON,PLUG:SNAP-IN MTG	57771	D3933 NICKEL
-198	179-2105-01			1	WIRING HARNESS,:CHASSIS	80009	ORD BY DESCR
-199	131-0707-00			76	.CONTACT,ELEC:22-26 AWG,BRS & CU BE GOLD	22526	47439-000
	131-0621-00			198	.CONNECTOR,TERM:22-26 AWG,BRS & CU BE GOLD	22526	46231-000
	131-0622-00			20	.CONTACT,ELEC:0.577"L,28-32 AWG WIRE	22526	46241-000
	131-0792-00			23	.CONNECTOR,TERM:18-20 AWG,CU BE GOLD PL	22526	46221
-200	210-0774-00			1	.EYELET,METALLIC:0.152 OD X 0.245 INCH L,	80009	210-0774-00
-201	210-0775-00			1	.EYELET,METALLIC:0.126 OD X 0.23 INCH L,	80009	210-0775-00
-202	352-0169-00			1	.HLDR,TERM CONN:2 WIRE,BLACK	80009	352-0169-00
-203	352-0161-08			1	.CONN BODY,PL,EL:3 WIRE GRAY	80009	352-0161-08
-204	352-0163-09			1	.HLDR,TERM CONN:5 WIRE,WHITE	80009	352-0163-09
-205	352-0168-01			1	.HLDR,TERM CONN:10 WIRE,BROWN	80009	352-0168-01
	352-0168-02			1	.HLDR,TERM CONN:10 WIRE,RED	80009	352-0168-02
	352-0168-03			1	.HLDR,TERM CONN:10 WIRE,ORANGE	80009	352-0168-03
	352-0168-04			1	.HLDR,TERM CONN:10 WIRE,YELLOW	80009	352-0168-04
	352-0168-05			1	.HLDR,TERM CONN:10 WIRE,GREEN	80009	352-0168-05
	352-0168-06			1	.HLDR,TERM CONN:10 WIRE,BLUE	80009	352-0168-06
	352-0168-07			1	.HLDR,TERM CONN:10 WIRE,VIOLET	80009	352-0168-07
-206	352-0198-00			8	.HLDR,TERM CONN:2 WIRE BLACK	80009	352-0198-00
-207	352-0199-00			5	.CONN BODY,PL,EL:3 WIRE BLACK	80009	352-0199-00
-208	352-0200-00			4	.HLDR,TERM CONN:4 WIRE BLACK	80009	352-0200-00
-209	352-0201-00			2	.CONN BODY,PL,EL:5 WIRE BLACK	80009	352-0201-00
-210	352-0202-00			6	.HLDR,TERM CONN:6 WIRE BLACK	80009	352-0202-00
-211	352-0203-00			1	.HLDR,TERM CONN:7 WIRE BLACK	80009	352-0203-00
-212	352-0204-00			8	.CONN BODY,PL,EL:8 WIRE BLACK	80009	352-0204-00
-213	352-0205-00			1	.CONN BODY,PL,EL:9 WIRE BLACK	80009	352-0205-00
-214	352-0206-00			4	.HLDR,TERM CONN:10 WIRE BLACK	80009	352-0206-00
	352-0199-01			1	.HLDR,TERM CONN:3 WIRE BROWN	80009	352-0199-01

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
2-	352-0201-01			1	.CONN BODY,PL,EL:5 WIRE BROWN	80009	352-0201-01
	352-0198-03			1	.HLDR,TERM CONN:2 WIRE ORANGE	80009	352-0198-03
	352-0199-03			1	.CONN BODY,PL,EL:3 WIRE ORANGE	80009	352-0199-03
	352-0201-03			1	.CONN BODY,PL,EL:5 WIRE ORANGE	80009	352-0201-03
	352-0199-04			2	.CONN BODY,PL,EL:3 WIRE YELLOW	80009	352-0199-04
	352-0200-04			2	.HLDR,TERM CONN:4 WIRE YELLOW	80009	352-0200-04
	352-0198-05			1	.HLDR,TERM CONN:2 WIRE GREEN	80009	352-0198-05
	352-0199-07			1	.HLDR,TERM CONN:3 WIRE VIOLET	80009	352-0199-07
	352-0200-07			1	.CONN BODY,PL,EL:4 WIRE VIOLET	80009	352-0200-07
	352-0201-07			1	.CONN BODY,PL,EL:5 WIRE VIOLET	80009	352-0201-07
	179-2106-00			1	WIRING HARNESS,:FRONT PANEL	80009	179-2106-00
	131-0707-00			72	.CONTACT,ELEC:22-26 AWG,BRS & CU BE GOLD	22526	47439-000
	352-0169-00			1	.HLDR,TERM CONN:2 WIRE,BLACK	80009	352-0169-00
	352-0163-09			1	.HLDR,TERM CONN:5 WIRE,WHITE	80009	352-0163-09
	352-0168-01			1	.HLDR,TERM CONN:10 WIRE,BROWN	80009	352-0168-01
	352-0168-02			1	.HLDR,TERM CONN:10 WIRE,RED	80009	352-0168-02
	352-0168-03			1	.HLDR,TERM CONN:10 WIRE,ORANGE	80009	352-0168-03
	352-0168-04			1	.HLDR,TERM CONN:10 WIRE,YELLOW	80009	352-0168-04
	352-0168-05			1	.HLDR,TERM CONN:10 WIRE,GREEN	80009	352-0168-05
	352-0168-06			1	.HLDR,TERM CONN:10 WIRE,BLUE	80009	352-0168-06
	352-0168-07			1	.HLDR,TERM CONN:10 WIRE,VIOLET	80009	352-0168-07
	198-2600-00			1	WIRE SET,ELEC:	80009	198-2600-00

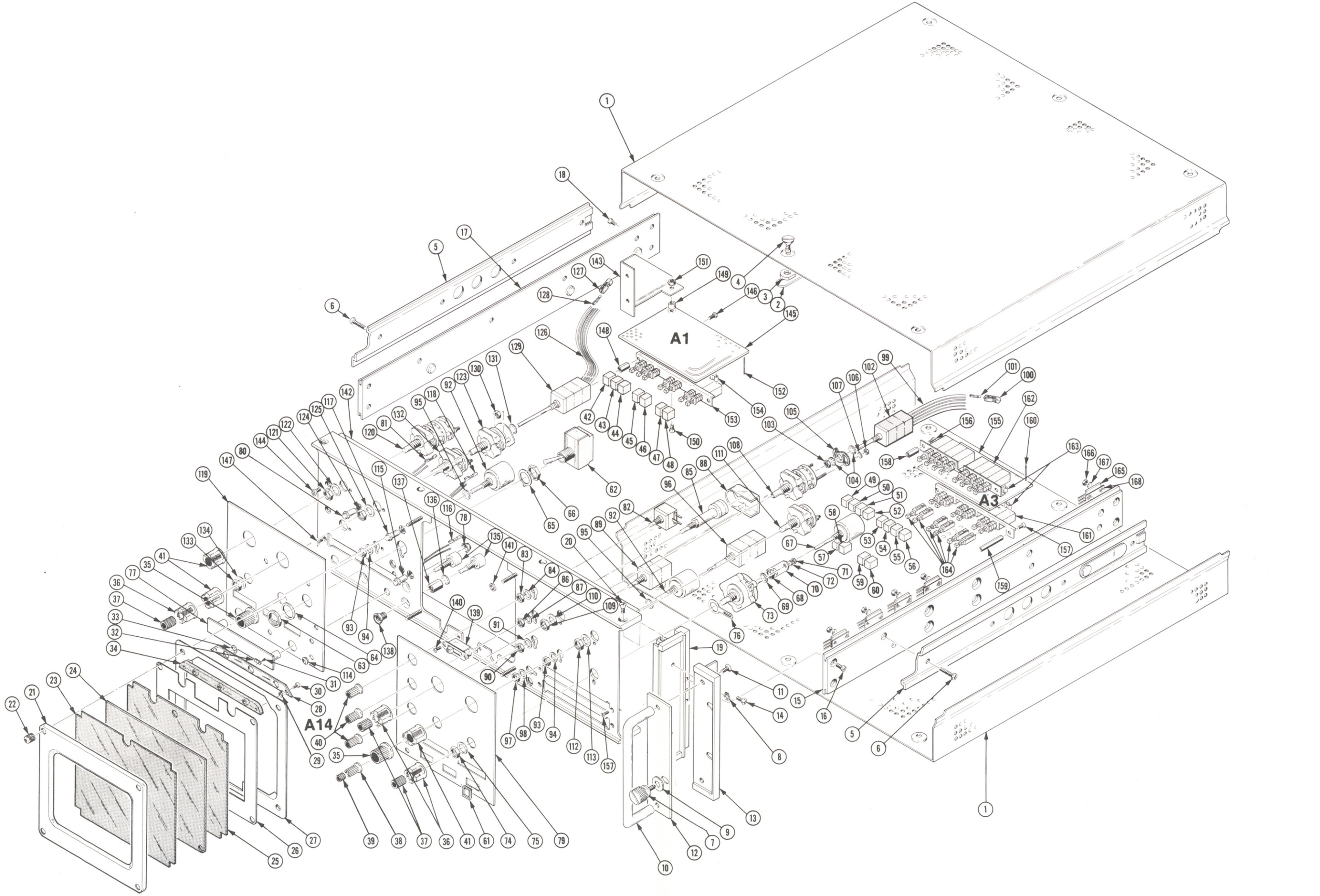
Fig. & Index No.	Tektronix Part No.	Serial/Model No.		Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
		Eff	Dscont				
3-1	390-0439-00			2	COVER,MONITOR:TV GRAY	80009	390-0439-00
-2	386-1151-00			1	.CLAMP,RIM CLENC:SPG STL CD PL	80009	386-1151-00
-3	386-0227-04			1	.STOP,CLP,RIM CL:SIL GY DELRIN	80009	386-0227-04
	214-0603-02			1	.PIN ASSY,SECRG:	80009	214-0603-02
	214-0604-00			1	..WASH.,SPG TNSN:0.26 ID X 0.47 INCH OD	80009	214-0604-00
-4	214-0603-01			1	..PIN,SECURING:0.27 INCH LONG	80009	214-0603-01
-5	351-0104-03			1	SL SECT,DWR EXT:12.625 L,W/O HARDWARE	06666	C-720-3
					**************(ATTACHING PARTS)***********		
-6	212-0023-00			6	SCREW,MACHINE:8-32 X 0.375,PNH,STL,CD PL	83385	ORD BY DESCR
					***********(END ATTACHING PARTS)*********		
-7	214-0239-00			2	THUMBSCREW:10-32 X 1.156 INCH LONG	80009	214-0239-00
-8	354-0175-00	B060000	B080614	2	RING,RETAINING:TYPE EXT,U/O 0.188 ID SFT	79136	5133-18-MI
	354-0025-00	B080615		2	RING,RETAINING:EXTERNAL,U/O 0.187 DIA SFT	79136	5555-18
	210-0894-00	B080615		2	WASHER,FLAT:0.19 ID X 0.031 THK	09422	ORD BY DESCR
-9	210-0917-00			2	WASHER,FLAT:0.191 ID X 0.25 THK,TEFLON	86445	ORD BY DESCR
-10	367-0104-00			2	HANDLE,BOW:4.076 L,AL CRPL	80009	367-0104-00
					**************(ATTACHING PARTS)***********		
-11	212-0574-00			2	SCREW,MACHINE:10-32 X 0.438"100 DEG FLH S	83385	ORD BY DESCR
					***********(END ATTACHING PARTS)*********		
-12	386-3117-00			2	PLATE,TRIM:FRONT	80009	386-3117-00
-13	407-0570-03			2	BRACKET,ANGLE:FRONT,RIGHT & LEFT AL	80009	407-0570-03
					**************(ATTACHING PARTS)***********		
-14	212-0070-00			4	SCREW,MACHINE:8-32 X 0.312"100 DEG,FLH ST	T0435	ORD BY DESCR
					***********(END ATTACHING PARTS)*********		
-15	426-1172-00			1	FRAME SECT,CAB.:LEFT	80009	426-1172-00
					**************(ATTACHING PARTS)***********		
-16	212-0004-00	B060000	B063505	4	SCREW,MACHINE:8-32 X 0.312 INCH,PNH STL	83385	ORD BY DESCR
	212-0043-00	B063506		4	SCREW,MACHINE:8-32 X 0.500 INCH,FLH STL	83385	ORD BY DESCR
					***********(END ATTACHING PARTS)*********		
-17	426-1173-00			1	FRAME SECT,CAB.:RIGHT	80009	426-1173-00
					**************(ATTACHING PARTS)***********		
-18	212-0004-00	B060000	B063505	4	SCREW,MACHINE:8-32 X 0.312 INCH,PNH STL	83385	ORD BY DESCR
	212-0043-00	B063506		4	SCREW,MACHINE:8-32 X 0.500 INCH,FLH STL	83385	ORD BY DESCR
					***********(END ATTACHING PARTS)*********		
-19	426-0482-06	B060000	B064772	2	FRAME SECT,CAB.:UPRIGHT FRONT	80009	426-0482-06
	426-0482-10	B064773		2	FRAME SECT,CAB.:UPRIGHT,REAR CORNER	80009	426-0482-10
					**************(ATTACHING PARTS)***********		
-20	212-0070-00			2	SCREW,MACHINE:8-32 X 0.312"100 DEG,FLH ST	T0435	ORD BY DESCR
					***********(END ATTACHING PARTS)*********		
-21	200-1711-00			1	RTNR,CRT SCALE:5.5 X 5.0,AL TV GRAY	80009	200-1711-00
					**************(ATTACHING PARTS)***********		
-22	210-0434-00			4	NUT,PLAIN,KNURL:10-32 X 0.375 INCH	80009	210-0434-00
					***********(END ATTACHING PARTS)*********		
-23	337-2216-00			1	SHIELD,ELEC:(FOR 1480 SERIES)	80009	337-2216-00
-24	378-0560-00			1	FILTER,LT,CRT:SMK GY,5.4 X 4.375 X 0.03	80009	378-0560-00
-25	331-0393-00			1	SCALE,CRT:BLANK,CLEAR	80009	331-0393-00
	331-0393-05			1	SCALE,CRT:CCIR K FACTOR ,VISUAL,CLEAR	80009	331-0393-05
	----- -----			-	(1481R,1485R ONLY)		
	331-0393-07	B079714		1	SCALE,CRT:CCIR K FACTOR,PHOTO,CLEAR	80009	331-0393-07
	----- -----			-	(1481R,1485R ONLY)		
	331-0393-08	B079714		1	SCALE,CRT:EXT,NTSC,A 100%,CLEAR	80009	331-0393-08
	----- -----			-	(1485R ONLY)		
	331-0393-10	B079714		1	SCALE,CRT:EXT,NTSC A PHOTO,CLEAR	80009	331-0393-10
	----- -----			-	(1485R ONLY)		
	331-0393-17	B079714		1	SCALE,CRT:IEEE STANDARD 511-1979	80009	331-0393-17
	----- -----			-	(1480R,1482R,1485R ONLY)		
	331-0393-18	B079714		1	SCALE,CRT:IEEE STANDARD 511-1979,PHOT	80009	331-0393-18
	----- -----			-	(1480R,1482R,1485R ONLY)		
-26	331-0399-00	B060000	B063505	1	MASK,CRT SCALE:	80009	331-0399-00
	331-0399-01	B063506		1	SCALE,CRT:	85471	ORD BY DESCR
-27	331-0364-00			1	MASK,SCALE,CRT:CRT	80009	331-0364-00

Fig. & Index No.	Tektronix Part No.	Serial/Model No.		Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
		Eff	Dscont				
3-28	----- -----			1	CKT BOARD ASSY:CRT SCALE LIGHT		
	----- -----			-	(SEE A14 REPL)		
					*************(ATTACHING PARTS)**********		
-29	210-0994-00			2	WASHER,FLAT:0.125 ID X 0.25" OD,STL	86928	5702-201-20
-30	211-0062-00			2	SCREW,MACHINE:2-56 X 0.312,PNH,STL	83385	ORD BY DESCR
					***********(END ATTACHING PARTS)********		
				-	CKT BOARD ASSY INCLUDES:		
-31	210-0759-00			3	.EYELET,METALLIC:0.61 OD X 0.192 INCH L,BR	71590	30818-11
-32	131-0704-00			3	.CONTACT,ELEC:SCALE LIGHTS,CU BE	80009	131-0704-00
-33	210-0957-00			3	.WASHER,FLAT:0.0625 ID X 0.125" OD,STL	83903	ORD BY DESCR
-34	378-0614-00			1	REFLECTOR,LIGHT:MOLDED PLASTIC	80009	378-0614-00
-35	366-0497-00			2	KNOB:GY,0.127 ID X 0.706 OD	80009	366-0497-00
	213-0153-00			4	.SETSCREW:5-40 X 0.125,STL BK OXD,HEX	000CY	ORD BY DESCR
-36	366-1190-00			1	KNOB:GRAY	80009	366-1190-00
	366-1037-00			3	KNOB:GRAY	80009	366-1037-00
	----- -----			-	(1481,1482 & 1485 ONLY)		
	213-0153-00			6	.SETSCREW:5-40 X 0.125,STL BK OXD,HEX	000CY	ORD BY DESCR
-37	366-1189-01			2	KNOB:GRAY--VAR	80009	366-1189-01
	213-0153-00			4	.SETSCREW:5-40 X 0.125,STL BK OXD,HEX	000CY	ORD BY DESCR
-38	366-1077-00			1	KNOB:GRAY	80009	366-1077-00
	213-0153-00			1	.SETSCREW:5-40 X 0.125,STL BK OXD,HEX	000CY	ORD BY DESCR
-39	366-1319-02			1	KNOB:GY,0.79 ID,0.28 OD,0.32 H	80009	366-1319-02
	213-0239-00			1	.SETSCREW:3-48 X 0.062 INCH,HEX SOC	71159	ORD BY DESCR
-40	366-1189-00			3	KNOB:GY,0.127 ID X 0.5 OD X 0.53	80009	366-1189-00
	213-0153-00			3	.SETSCREW:5-40 X 0.125,STL BK OXD,HEX	000CY	ORD BY DESCR
-41	366-0500-00			4	KNOB:GRAY,4 SIDED	80009	366-0500-00
	213-0153-00			8	.SETSCREW:5-40 X 0.125,STL BK OXD,HEX	000CY	ORD BY DESCR
-42	366-1328-30			1	PUSH BUTTON:SLOW	80009	366-1328-30
-43	366-1489-97			1	PUSH BUTTON:FAST	80009	366-1489-97
-44	366-1402-98			1	PUSH BUTTON:OFF	80009	366-1402-98
-45	366-1328-35			1	PUSH BUTTON:BACK PORCH	80009	366-1328-35
-46	366-1557-01			1	PUSH BUTTON:SYNC TIP	80009	366-1557-01
-47	366-1328-34			1	PUSH BUTTON:OPERATE	80009	366-1328-34
-48	366-1489-98			1	PUSH BUTTON:CAL	80009	366-1489-98
-49	366-1328-31			1	PUSH BUTTON:"1"	80009	366-1328-31
	----- -----			-	(1480,1481,1482,1485,OPT 01 & 07 ONLY)		
-50	366-1328-32			2	PUSH BUTTON:CHARCOAL,3	80009	366-1328-32
	----- -----			-	(1481,1482,1485,OPT 01 & 07 ONLY)		
-51	366-1489-99			2	PUSH BUTTON:"2"	80009	366-1489-99
	----- -----			-	(1480,1481,1482,1485,OPT 01 & 07 ONLY)		
-52	366-1557-00			1	PUSH BUTTON:SIL GY,4	80009	366-1557-00
	----- -----			-	(1481,1482,1485,OPT 01 & 07 ONLY)		
-53	366-1328-29			1	PUSH BUTTON:OFF	80009	366-1328-29
-55	366-1557-02			1	PUSH BUTTON:VAR	80009	366-1557-02
-56	366-1557-04			1	PUSH BUTTON:15 LINES	80009	366-1557-04
-57	366-1328-33			1	PUSH BUTTON:INT	80009	366-1328-33
-58	366-1489-43			1	PUSH BUTTON:SIL GY,EXT	80009	366-1489-43
-59	366-1328-36			1	PUSH BUTTON:AFC	80009	366-1328-36
-60	366-1489-96			1	PUSH BUTTON:DIRECT	80009	366-1489-96
-61	426-0681-01			19	FRAME,PUSH BTN:	80009	426-0681-01
-62	----- -----			1	SWITCH,TOGGLE:(SEE S9836 REPL)		
					*************(ATTACHING PARTS)**********		
-63	210-0473-00			1	NUT,PLAIN,DODEC:0.469-32 X 0.638 INCH,BRS	80009	210-0473-00
-64	210-0902-00			1	WASHER,FLAT:0.470 ID X 0.656 INCH OD,ST	12327	ORD BY DESCR
	210-0021-00	B064773		1	WASHER,LOCK:INTL,0.476IDX0.018THK,STL	78189	1222-01
-65	354-0055-00			1	WASHER,KEY:0.469 ID X 0.688 INCH OD,ST	80009	354-0055-00
-66	210-0414-00			1	NUT,PLAIN,HEX.:0.468-32 X 0.562 INCH,BRS	73743	3167-402
					***********(END ATTACHING PARTS)********		
-67	----- -----			1	RES.,VARIABLE:(SEE R9992,S9981 REPL)		
					*************(ATTACHING PARTS)**********		
-68	210-0583-00			1	NUT,PLAIN,HEX:0.25-32 X 0.312 INCH,BRS	73743	2X20317-402
-69	210-0046-00	B060000	B079129	1	WASHER,LOCK:0.261 ID,INTL,0.018 THK,BRS	77900	1214-05-00-0541C
	210-1026-00	B079130		1	WASHER,LOCK:0.26 ID,INTL,0.025 THK,STL	78189	1114-00
					***********(END ATTACHING PARTS)********		

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
3-70	386-3476-00	B060000	B079129	1	PLATE,CMPNT MTG:RESISTOR	80009	386-3476-00
	----- -----			-	(1480R ONLY)		
	386-3476-01	B079130		1	PLATE,CMPNT MTG:RESISTOR	80009	386-3476-01
	----- -----			-	(1480R ONLY)		
	386-3476-00	B060000	B073159	1	PLATE,CMPNT MTG:RESISTOR	80009	386-3476-00
	----- -----			-	(1480C ONLY)		
	386-3476-01	B073160		1	PLATE,CMPNT MTG:RESISTOR	80009	386-3476-01
	----- -----			-	(1480C ONLY)		
					*************(ATTACHING PARTS)***********		
-71	210-0406-00			2	NUT,PLAIN,HEX:4-40 X 0.188,BRS,CD PL	73743	12161-50
-72	210-0004-00			2	WASHER,LOCK:#4 INTL,0.015 THK,STL CD PL	77900	1204-00-000541C
					***********(END ATTACHING PARTS)*********		
-73	----- -----			1	SWITCH,ROTARY:(SEE S9992 REPL)		
					*************(ATTACHING PARTS)***********		
-74	210-0590-00			1	NUT,PLAIN,HEX.:0.375-32 X 0.438" BRS	73743	2X28269-402
-75	210-0978-00			1	WASHER,FLAT:0.375 ID X 0.50 INCH OD,STL	12327	ORD BY DESCR
					***********(END ATTACHING PARTS)*********		
-76	210-0207-00			1	TERMINAL,LUG:0.375 INCH DIAMETER	12697	01136902
-77	200-1784-00			1	COVER,CONN HOLE:PROBE	80009	200-1784-00
					*************(ATTACHING PARTS)***********		
-78	220-0743-00			2	NUT,STAMPED:0.187 THD X 0.217 H,CD PL	80009	220-0743-00
					***********(END ATTACHING PARTS)*********		
-79	333-1910-04			2	PANEL,FRONT:	80009	333-1910-04
	333-1985-02			1	PANEL,FRONT:	80009	333-1985-02
	333-1986-02			1	PANEL,FRONT:	80009	333-1986-02
-80	----- -----			3	LAMP,CARTRIDGE:		
	----- -----			-	(SEE DS9820,DS9896,DS9980 REPL)		
-81	131-0621-00			1	.CONNECTOR,TERM:22-26 AWG,BRS & CU BE GOLD	22526	46231-000
-82	----- -----			1	RES.,VARIABLE:(SEE R9880 REPL)		
					*************(ATTACHING PARTS)***********		
-83	210-0583-00			1	NUT,PLAIN,HEX:0.25-32 X 0.312 INCH,BRS	73743	2X20317-402
-84	210-0940-00			1	WASHER,FLAT:0.25 ID X 0.375 INCH OD,STL	79807	ORD BY DESCR
					***********(END ATTACHING PARTS)*********		
-85	----- -----			1	RES.,VARIABLE:(SEE R9882 REPL)		
					*************(ATTACHING PARTS)***********		
-86	210-0583-00			2	NUT,PLAIN,HEX:0.25-32 X 0.312 INCH,BRS	73743	2X20317-402
-87	210-0940-00			1	WASHER,FLAT:0.25 ID X 0.375 INCH OD,STL	79807	ORD BY DESCR
					***********(END ATTACHING PARTS)*********		
-88	200-0608-00			1	COVER,VAR RES.,:PLASTIC:	80009	200-0608-00
-89	----- -----			1	RES.,VARIABLE:(SEE R9980 REPL)		
					*************(ATTACHING PARTS)***********		
-90	210-0583-00			1	NUT,PLAIN,HEX:0.25-32 X 0.312 INCH,BRS	73743	2X20317-402
-91	210-0940-00			1	WASHER,FLAT:0.25 ID X 0.375 INCH OD,STL	79807	ORD BY DESCR
					***********(END ATTACHING PARTS)*********		
-92	----- -----			2	RES.,VARIABLE:(SEE R9925,R9990 REPL)		
					*************(ATTACHING PARTS)***********		
-93	210-0583-00			4	NUT,PLAIN,HEX:0.25-32 X 0.312 INCH,BRS	73743	2X20317-402
-94	210-0940-00			2	WASHER,FLAT:0.25 ID X 0.375 INCH OD,STL	79807	ORD BY DESCR
-95	210-0046-00			2	WASHER,LOCK:0.261 ID,INTL,0.018 THK,BRS	77900	1214-05-00-0541C
					***********(END ATTACHING PARTS)*********		
-96	----- -----			1	RES.,VARIABLE:(SEE R9982 REPL)		
					*************(ATTACHING PARTS)***********		
-97	210-0583-00			1	NUT,PLAIN,HEX:0.25-32 X 0.312 INCH,BRS	73743	2X20317-402
	210-0807-00	B062816		1	WASHER,FLAT:0.312 ID X 0.05 THK,STL	12327	ORD BY DESCR
	----- -----			-	(CABINET ONLY)		
	210-0807-00	B068105		1	WASHER,FLAT:0.312 ID X 0.05 THK,STL	12327	ORD BY DESCR
	----- -----			-	(RACKMOUNT ONLY)		
-98	210-0940-00			1	WASHER,FLAT:0.25 ID X 0.375 INCH OD,STL	79807	ORD BY DESCR
					***********(END ATTACHING PARTS)*********		
-99	195-0185-00			1	LEAD SET,ELEC:17.0 L,FRONT PANEL CONTROL	80009	195-0185-00
-100	352-0197-00			3	.CONN BODY,PL,EL:1 WIRE BLACK	80009	352-0197-00
-101	131-0621-00			3	.CONNECTOR,TERM:22-26 AWG,BRS & CU BE GOLD	22526	46231-000

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
3-102	----- -----			1	RES.,VARIABLE:(SEE R9892,S9892 REPL)		
					**************(ATTACHING PARTS)***********		
-103	210-0465-00			1	NUT,PLAIN,HEX.:0.25-32 X 0.375 INCH BRS	73743	3095-402
-104	210-0046-00			2	WASHER,LOCK:0.261 ID,INTL,0.018 THK,BRS	77900	1214-05-00-0541C
					************(END ATTACHING PARTS)*********		
-105	426-0474-00			1	MOUNT,RESILIENT:S SHAPE	80009	426-0474-00
					**************(ATTACHING PARTS)***********		
-106	210-0406-00			2	NUT,PLAIN,HEX:4-40 X 0.188,BRS,CD PL	73743	12161-50
-107	210-0004-00			2	WASHER,LOCK:#4 INTL,0.015 THK,STL CD PL	77900	1204-00-000541C
					************(END ATTACHING PARTS)*********		
-108	----- -----			1	SWITCH,ROTARY:(SEE S9890 REPL)		
					**************(ATTACHING PARTS)***********		
-109	210-0590-00			1	NUT,PLAIN,HEX.:0.375-32 X 0.438" BRS	73743	2X28269-402
-110	210-0978-00			1	WASHER,FLAT:0.375 ID X 0.50 INCH OD,STL	12327	ORD BY DESCR
					************(END ATTACHING PARTS)*********		
-111	----- -----			1	SWITCH,ROTARY:(SEE S9891 REPL)		
					**************(ATTACHING PARTS)***********		
-112	210-0590-00			1	NUT,PLAIN,HEX.:0.375-32 X 0.438" BRS	73743	2X28269-402
-113	210-0978-00			1	WASHER,FLAT:0.375 ID X 0.50 INCH OD,STL	12327	ORD BY DESCR
					************(END ATTACHING PARTS)*********		
-114	358-0301-00			2	BUSHING,SLEEVE:FOR 0.185 DIA HOLE,GRAY	80009	358-0301-00
-115	----- -----			2	LAMP,CARTRIDGE:(SEE DS9930,DS9990 REPL)		
-116	131-0707-00			2	.CONTACT,ELEC:22-26 AWG,BRS & CU BE GOLD	22526	47439-000
-117	----- -----			1	LAMP,CARTRIDGE:(SEE DS9836 REPL)		
-118	131-0707-00			1	.CONTACT,ELEC:22-26 AWG,BRS & CU BE GOLD	22526	47439-000
-119	333-1961-01			1	PANEL,FRONT:LEFT	80009	333-1961-01
-120	----- -----			1	SWITCH,ROTARY:(SEE S9815 REPL)		
					**************(ATTACHING PARTS)***********		
-121	210-0590-00			1	NUT,PLAIN,HEX.:0.375-32 X 0.438" BRS	73743	2X28269-402
-122	210-0978-00			1	WASHER,FLAT:0.375 ID X 0.50 INCH OD,STL	12327	ORD BY DESCR
					************(END ATTACHING PARTS)*********		
-123	----- -----			1	SWITCH,ROTARY:(SEE S9828 REPL)		
					**************(ATTACHING PARTS)***********		
-124	210-0590-00			1	NUT,PLAIN,HEX.:0.375-32 X 0.438" BRS	73743	2X28269-402
-125	210-0978-00			1	WASHER,FLAT:0.375 ID X 0.50 INCH OD.STL	12327	ORD BY DESCR
					************(END ATTACHING PARTS)*********		
-126	195-0144-00			1	LEAD SET,ELEC:FRONT PANEL CONTROL	80009	195-0144-00
-127	352-0197-00			3	.CONN BODY,PL,EL:1 WIRE BLACK	80009	352-0197-00
-128	131-0621-00			3	.CONNECTOR,TERM:22-26 AWG,BRS & CU BE GOLD	22526	46231-000
-129	----- -----			1	RES.,VARIABLE:(SEE R9828,S9820 REPL)		
					**************(ATTACHING PARTS)***********		
-130	210-0583-00			1	NUT,PLAIN,HEX:0.25-32 X 0.312 INCH,BRS	73743	2X20317-402
-131	210-0046-00			1	WASHER,LOCK:0.261 ID,INTL,0.018 THK,BRS	77900	1214-05-00-0541C
					************(END ATTACHING PARTS)*********		
-132	----- -----			1	SWITCH,ROTARY:(SEE S9915 REPL)		
					**************(ATTACHING PARTS)***********		
-133	210-0590-00			1	NUT,PLAIN,HEX.:0.375-32 X 0.438" BRS	73743	2X28269-402
-134	210-0978-00			1	WASHER,FLAT:0.375 ID X 0.50 INCH OD,STL	12327	ORD BY DESCR
					************(END ATTACHING PARTS)*********		
-135	----- -----			2	RES.,VARIABLE:(SEE R9935,R9940 REPL)		
-136	210-0046-00			2	WASHER,LOCK:0.261 ID,INTL,0.018 THK,BRS	77900	1214-05-00-0541C
-137	129-0582-00			2	SPACER,POST:0.67 LONG X W/0.25-32 THD	80009	129-0582-00
					**************(ATTACHING PARTS)***********		
-138	358-0422-00	B060000	B063505	2	BSHG,MACH.THD:0.25-32 X 0.187" LONG BRS	80009	358-0422-00
	358-0409-00	B063506		2	BSHG,MACH.THD:0.25-32 X 0.159 ID X 0.24	80009	358-0409-00
					************(END ATTACHING PARTS)*********		
-139	----- -----			1	SWITCH,SLIDE:		
					**************(ATTACHING PARTS)***********		
-140	211-0022-00	B060000	B063505	2	SCREW,MACHINE:2-56 X 0.188,PNH,STL,CD PL	83385	ORD BY DESCR
	213-0138-00	B063506		2	SCR,TPG,TF:4-24 X 0.188 INCH,PNH STL	83385	ORD BY DESCR
					************(END ATTACHING PARTS)*********		
-141	210-0813-00			4	WSHR,SHOULDERED:# 10 FIBER	74921	ORD BY DESCR

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
3-142	386-3091-00	B060000	B064772	1	SUBPANEL,FRONT:	80009	386-3091-00
	386-3091-02	B064773		1	SUBPANEL,FRONT:	80009	386-3091-02
-143	407-1553-00	B060000	B064091	1	BRACKET,CKT BD:ALUMINUM	80009	407-1553-00
	----- -----			-	(RACKMOUNT ONLY)		
	407-1553-01	B064092		1	BRACKET,CKT BD:	80009	407-1553-01
	----- -----			-	(RACKMOUNT ONLY)		
					**************(ATTACHING PARTS)***********		
-144	211-0538-00			2	SCREW,MACHINE:6-32 X 0.312"100 DEG,FLH	83385	ORD BY DESCR
					************(END ATTACHING PARTS)*********		
-145	----- -----			1	CKT BOARD ASSY:VERTICAL SWTICH		
	----- -----			-	(SEE A1 REPL)		
					**************(ATTACHING PARTS)***********		
-146	211-0232-00			2	SCREW,MACHINE:4-40 X 0.25 INCH,FIL STL	83385	ORD BY DESCR
-147	211-0038-00			2	SCREW,MACHINE:4-40 X 0.312,FLH,100 DEG	83385	ORD BY DESCR
-148	129-0308-00			2	POST,ELEC-MECH:HEX.,0.25 X 0.465 INCH LONG	80009	129-0308-00
-149	129-0214-00			1	INSULATOR,STDF:DELRIN	80009	129-0214-00
-150	211-0014-00			1	SCREW,MACHINE:4-40 X 0.50,PHN STL,POZ	83385	ORD BY DESCR
-151	210-0586-00			1	NUT,PL,ASSEM WA:4-40 X 0.25,STL CD PL	T0435	ORD BY DESCR
					************(END ATTACHING PARTS)*********		
	----- -----			-	CKT BOARD ASSY INCLUDES:		
-152	131-0589-00			28	.TERMINAL,PIN:0.46 L X 0.025 SQ	22526	48283-029
-153	----- -----			1	.SWITCH,PUSH:(SEE S2210,S2220,S2230,		
	----- -----			-	.S2250,S2255,S2270,S2280 REPL)		
	361-0969-00	B064320	B065929	2	.SPACER,SWITCH:0.2 X 0.13,AL	80009	361-0969-00
	361-0969-01	B065930	B079314	2	.SPACER,SWITCH:0.2 X 0.13,AL	80009	361-0969-01
	214-3145-00	B079315		1	.CLIP,SW RTNG:CU BE	80009	214-3145-00
	211-0061-00	B079315		1	.SCREW,MACHINE:4-40 X 0.50,FILH,STL,CD PL	83385	ORD BY DESCR
-154	361-0384-00			8	.SPACER,PB SW:0.133L,RED POLYCARBONATE	80009	361-0384-00
-155	----- -----			1	CKT BOARD ASSY:HORIZONTAL SWITCH		
	----- -----			-	(SEE A3 REPL)		
					**************(ATTACHING PARTS)***********		
-156	211-0232-00	B060000	B065929	6	SCREW,MACHINE:4-40 X 0.25 INCH,FIL STL	83385	ORD BY DESCR
	211-0232-00	B065930		4	SCREW,MACHINE:4-40 X 0.25 INCH,FIL STL	83385	ORD BY DESCR
	211-0014-00	B065930	B079314	2	SCREW,MACHINE:4-40 X 0.50,PHN STL,POZ	83385	ORD BY DESCR
-157	211-0038-00			4	SCREW,MACHINE:4-40 X 0.312,FLH,100 DEG	83385	ORD BY DESCR
-158	129-0308-00			2	POST,ELEC-MECH:HEX..0.25 X 0.465 INCH LONG	80009	129-0308-00
-159	129-0427-00			2	POST,ELEC-MECH:4-40 X 0.188 X 1.056" L HEX	80009	129-0427-00
					************(END ATTACHING PARTS)*********		
	----- -----			-	CKT BOARD ASSY INCLUDES:		
-160	131-0589-00			19	.TERMINAL,PIN:0.46 L X 0.025 SQ	22526	48283-029
-161	----- -----			1	.SWITCH,PUSH:(SEE S5001,S5041,S5071 REPL)		
-162	----- -----			1	.SWITCH,PUSH:(SEE S5006,S5016,S5026,		
	----- -----			-	.S5036,S5056,S5076,S5086,S5096 REPL)		
-163	361-0384-00			14	.SPACER,PB SW:0.133L,RED POLYCARBONATE	80009	361-0384-00
	361-0969-00	B063920	B065929	2	.SPACER,SWITCH:0.2 X 0.13,AL	80009	361-0969-00
	361-0969-01	B065930	B079314	2	.SPACER,SWITCH:0.2 X 0.13,AL	80009	361-0969-01
	214-3145-00	B079315		1	.CLIP,SW RTNG:CU BE	80009	214-3145-00
	211-0061-00	B079315		1	.SCREW,MACHINE:4-40 X 0.50,FILH,STL,CD PL	83385	ORD BY DESCR
-164	384-1136-00			6	.EXTENSION SHAFT:0.95 INCH LONG	80009	384-1136-00
-165	----- -----			5	TRANSISTOR:(SEE Q9200,Q9300,		
	----- -----			-	Q9500,Q9700 REPL)		
					**************(ATTACHING PARTS)***********		
-166	210-0406-00			1	NUT,PLAIN,HEX:4-40 X 0.188,BRS,CD PL	73743	12161-50
-167	210-1122-00			1	WASHER,LOCK:0.12 ID,DISHED,0.025 THK	86928	ORD BY DESCR
-168	342-0163-00			1	INSULR,PLATE:XSTR,0.675 X 0.625 X 0.001"	80009	342-0163-00
					************(END ATTACHING PARTS)*********		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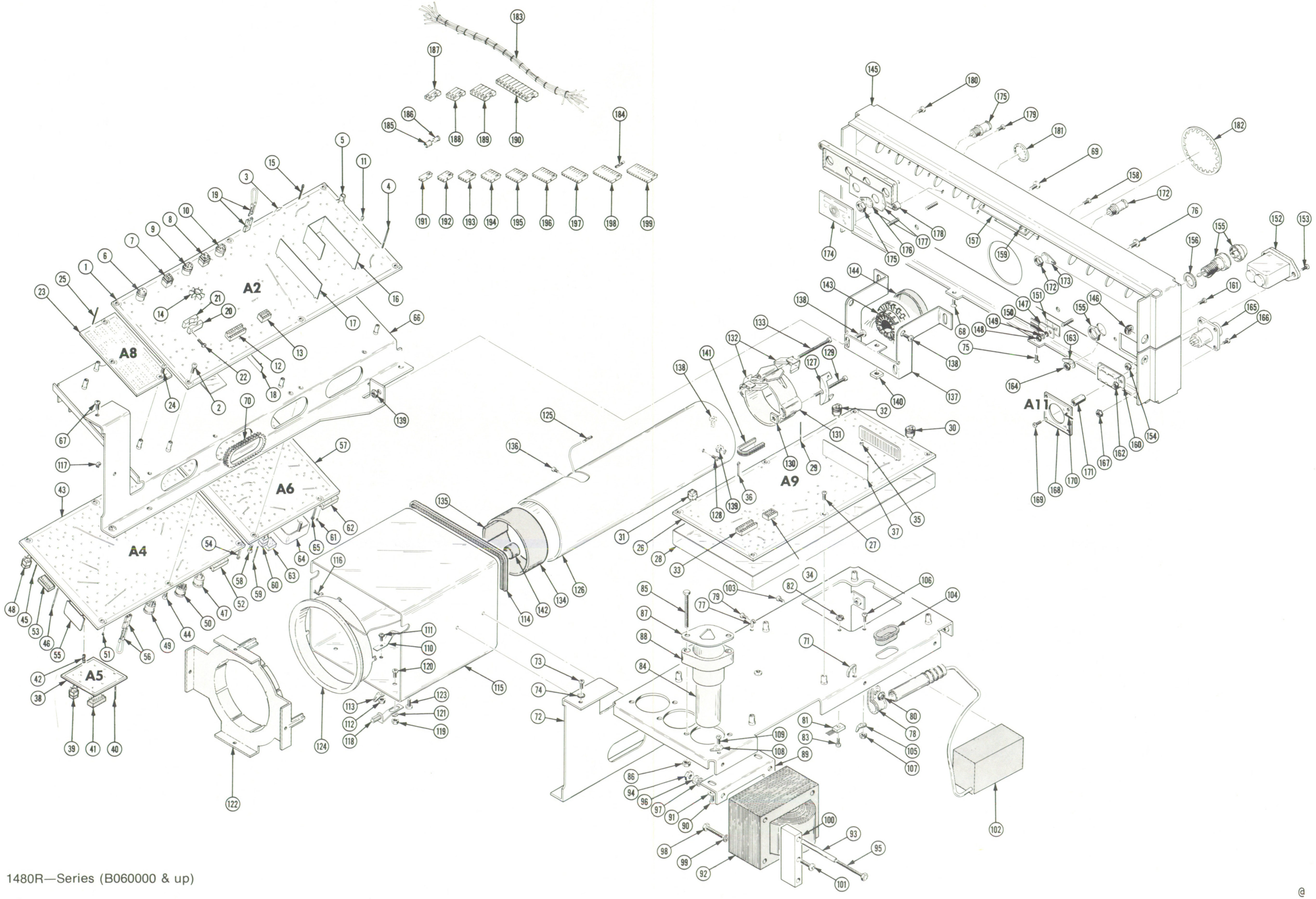
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1480R—Series (B060000 & up)

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
4-1	----- -----			1	CKT BOARD ASSY:VERTICAL AMPLIFIER		
	----- -----			-	(SEE A2 REPL)		
					**************(ATTACHING PARTS)**********		
-2	211-0007-00			6	SCREW,MACHINE:4-40 X 0.188,PNH STL,CD PL	83385	ORD BY DESCR
					************(END ATTACHING PARTS)*********		
	----- -----			-	CKT BOARD ASSY INCLUDES:		
-3	131-0566-00			3	.BUS CONDUCTOR:DUMMY RES,2.375,22 AWG	57668	JWW-0200E0
-4	131-0589-00			73	.TERMINAL,PIN:0.46 L X 0.025 SQ	22526	48283-029
	131-0608-00			6	.TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD	22526	48283-036
-5	131-1003-00			3	.CONN,RCPT,ELEC:CKT BD MT,3 PRONG	80009	131-1003-00
	136-0352-00			24	.CONTACT,ELEC:FOR 0.02 INCH DIAMETER PIN	00779	50462-7
-6	136-0183-00			2	.SOCKET,PLUG-IN:3 PIN,ROUND	80009	136-0183-00
-7	136-0219-00			2	.SOCKET,PLUG-IN:4 PIN	80009	136-0219-00
-8	136-0220-00	B060000	B067589	51	.SKT,PL-IN ELEK:TRANSISTOR 3 CONTACT,PCB M	71785	133-23-11-034
	136-0220-00	B067590		26	.SKT,PL-IN ELEK:TRANSISTOR 3 CONTACT,PCB M	71785	133-23-11-034
-9	136-0235-00			1	.SOCKET,PLUG-IN:6 CONTACT,ROUND	71785	133-96-12-062
-10	136-0237-00			1	.SOCKET,PLUG-IN:8 CONTACT,ROUND	71785	133-98-12-062
-11	136-0252-07			31	.SOCKET,PIN CONN:W/O DIMPLE	22526	75060-012
-12	136-0260-02			2	.SKT,PL-IN ELEK:MICROCIRCUIT,16 DIP,LOW CL	09922	DILB16P-108T
-13	136-0514-00			2	.SKT,PL-IN ELEC:MICROCIRCUIT,8 DIP	09922	DILB8P-108
-14	214-1292-00			2	.HEAT SINK,ELEC:TRANSISTOR	05820	205SB
-15	214-0579-00			6	.TERM,TEST POINT:BRS CD PL	80009	214-0579-00
-16	337-0950-00			1	.SHIELD,ELEC:CIRCUIT BOARD	80009	337-0950-00
-17	337-1456-00			1	.SHLD,ELECTRICAL:CKT BOARD MOUNT	80009	337-1456-00
-18	337-2068-00			1	.SHIELD,ELEC:CKT BOARD MOUNT	80009	337-2068-00
-19	131-0993-00			1	.BUS,CONDUCTOR:2 WIRE BLACK	00779	850100-01
	198-3171-00			1	.WIRE SET,ELEC:	80009	198-3171-00
-20	200-0945-00			5	.COVER,HALF XSTR:DUAL TO-18,ALUMINUM	80009	200-0945-00
-21	200-0945-01			5	.COVER,HALF XSTR:DUAL TO-18,W/2-56 THD	80009	200-0945-01
-22	211-0001-00			5	.SCREW,MACHINE:2-56 X 0.25 INCH,PNH STL	87308	ORD BY DESCR
-23	----- -----			1	CKT BOARD ASSY:FRONT PANEL CONNECTOR		
	----- -----			-	(SEE A8 REPL)		
					**************(ATTACHING PARTS)**********		
-24	211-0007-00			3	SCREW,MACHINE:4-40 X 0.188,PNH STL,CD PL	83385	ORD BY DESCR
					************(END ATTACHING PARTS)*********		
	----- -----			-	CKT BOARD ASSY INCLUDES:		
-25	131-0608-00			160	.TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD	22526	48283-036
-26	----- -----			1	CKT BOARD ASSY:POWER SUPPLY(SEE A9 REPL)		
					**************(ATTACHING PARTS)**********		
-27	211-0007-00			6	SCREW,MACHINE:4-40 X 0.188,PNH STL,CD PL	83385	ORD BY DESCR
-28	337-1997-00			1	SHIELD,ELEC:CIRCUIT CARD	80009	337-1997-00
					************(END ATTACHING PARTS)*********		
	----- -----			-	CKT BOARD ASSY INCLUDES:		
-29	131-0589-00			85	.TERMINAL,PIN:0.46 L X 0.025 SQ	22526	48283-029
-30	136-0183-00	B060000	B067589	8	.SOCKET,PLUG-IN:3 PIN,ROUND	80009	136-0183-00
	136-0183-00	B067590		2	.SOCKET,PLUG-IN:3 PIN,ROUND	80009	136-0183-00
-31	136-0220-00	B060000	B067589	5	.SKT,PL-IN ELEK:TRANSISTOR 3 CONTACT,PCB M	71785	133-23-11-034
	136-0220-00	B067590		3	.SKT,PL-IN ELEK:TRANSISTOR 3 CONTACT,PCB M	71785	133-23-11-034
-32	136-0235-00			1	.SOCKET,PLUG-IN:6 CONTACT,ROUND	71785	133-96-12-062
-33	136-0269-02			3	.SKT,PL-IN ELEK:MICROCIRCUIT,14 DIP	09922	DILB14P-108T
-34	136-0514-00			1	.SKT,PL-IN ELEC:MICROCIRCUIT,8 DIP	09922	DILB8P-108
-35	166-0292-00			3	.SPACER,SLEEVE:PLSTC,0.155 DIA X 0.065"L	80009	166-0292-00
-36	214-0579-00			9	.TERM,TEST POINT:BRS CD PL	80009	214-0579-00
	198-3430-00			1	.WIRE SET,ELEC:	80009	198-3430-00
-37	337-1456-00			1	.SHLD,ELECTRICAL:CKT BOARD MOUNT	80009	337-1456-00
-38	----- -----			1	CKT BOARD ASSY:PAL-M LINE COUNTER		
	----- -----			-	(SEE A5 REPL)		
-39	136-0220-00			1	.SKT,PL-IN ELEK:TRANSISTOR 3 CONTACT,PCB M	71785	133-23-11-034
-40	131-0608-00			6	.TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD	22526	48283-036
-41	136-0269-02			2	.SKT,PL-IN ELEK:MICROCIRCUIT,14 DIP	09922	DILB14P-108T
-42	136-0327-01			9	.SOCKET,PIN TERM:0.067 INCH DIA	00779	86281-2
-43	----- -----			1	CKT BOARD ASSY:SWEEP OUTPUT(SEE A4 REPL)		
					**************(ATTACHING PARTS)**********		
-44	211-0007-00			6	SCREW,MACHINE:4-40 X 0.188,PNH STL,CD PL	83385	ORD BY DESCR
					************(END ATTACHING PARTS)*********		

Fig. & Index No.	Tektronix Part No.	Serial/Model No.		Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
		Eff	Dscont				
4-	----- -----			-	CKT BOARD ASSY INCLUDES:		
-45	131-0589-00			80	.TERMINAL,PIN:0.46 L X 0.025 SQ	22526	48283-029
	131-0608-00			28	.TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD	22526	48283-036
-46	131-0787-00			9	.TERMINAL,PIN:0.64LX0.025SQ PH BRZ,GOLD	22526	47359-000
	198-2488-00	B063506		1	.WIRE SET,ELEC:	80009	198-2488-00
	352-0197-00	B063506		1	.CONN BODY,PL,EL:1 WIRE BLACK	80009	352-0197-00
	352-0198-00	B063506		1	.HLDR,TERM CONN:2 WIRE BLACK	80009	352-0198-00
-47	136-0183-00			4	.SOCKET,PLUG-IN:3 PIN,ROUND	80009	136-0183-00
-48	136-0220-00	B060000	B067589	29	.SKT,PL-IN ELEK:TRANSISTOR 3 CONTACT,PCB M	71785	133-23-11-034
	136-0220-00	B067590		9	.SKT,PL-IN ELEK:TRANSISTOR 3 CONTACT,PCB M	71785	133-23-11-034
-49	136-0235-00			2	.SOCKET,PLUG-IN:6 CONTACT,ROUND	71785	133-96-12-062
-50	136-0241-00			2	.SKT,PL-IN ELEK:MICROCIRCUIT,10 CONT,PCB M	71785	133-99-12-064
-51	136-0252-07			6	.SOCKET,PIN CONN:W/O DIMPLE	22526	75060-012
-52	136-0260-02			1	.SKT,PL-IN ELEK:MICROCIRCUIT,16 DIP,LOW CL	09922	DILB16P-108T
-53	136-0269-02			21	.SKT,PL-IN ELEK:MICROCIRCUIT,14 DIP	09922	DILB14P-108T
-54	214-0579-00			10	.TERM,TEST POINT:BRS CD PL	80009	214-0579-00
-55	337-2258-00			1	.SHIELD,ELEC:CIRCUIT BOARD	80009	337-2258-00
-56	131-0993-00			7	.BUS,CONDUCTOR:2 WIRE BLACK	00779	850100-01
-57	----- -----			1	CKT BOARD ASSY:SYNC & TIMING(SEE A6 REPL)		
					**************(ATTACHING PARTS)**********		
-58	211-0007-00			4	SCREW,MACHINE:4-40 X 0.188,PNH STL,CD PL	83385	ORD BY DESCR
					************(END ATTACHING PARTS)*********		
	----- -----			-	CKT BOARD ASSY INCLUDES:		
-59	131-0589-00			31	.TERMINAL,PIN:0.46 L X 0.025 SQ	22526	48283-029
	131-0608-00			2	.TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD	22526	48283-036
-60	136-0220-00	B060000	B067589	45	.SKT,PL-IN ELEK:TRANSISTOR 3 CONTACT,PCB M	71785	133-23-11-034
	136-0220-00	B067590		13	.SKT,PL-IN ELEK:TRANSISTOR 3 CONTACT,PCB M	71785	133-23-11-034
-61	136-0252-07			3	.SOCKET,PIN CONN:W/O DIMPLE	22526	75060-012
-62	136-0260-02			2	.SKT,PL-IN ELEK:MICROCIRCUIT,16 DIP,LOW CL	09922	DILB16P-108T
-63	136-0514-00			3	.SKT,PL-IN ELEC:MICROCIRCUIT,8 DIP	09922	DILB8P-108
-64	202-0196-01			1	.CAN,ALUMINUM:1.25 X 0.80 X 0.02 INCH THK	0000G	ORD BY DESCR
-65	214-0579-00			10	.TERM,TEST POINT:BRS CD PL	80009	214-0579-00
-66	441-1257-00			1	CHAS,ELEC EQPT:DEFLECTION	80009	441-1257-00
					**************(ATTACHING PARTS)**********		
-67	211-0504-00			6	SCREW,MACHINE:6-32 X 0.250,PNH STL,CD PL	83385	ORD BY DESCR
-68	211-0538-00			1	SCREW,MACHINE:6-32 X 0.312"100 DEG,FLH	83385	ORD BY DESCR
-69	211-0542-00			2	SCREW,MACHINE:6-32 X 0.312 INCH,TRH STL	83385	ORD BY DESCR
					************(END ATTACHING PARTS)*********		
-70	255-0334-00			2	PLASTIC CHANNEL:12.75 X 0.175 X 0.155,NYL	11897	122-37-2500
-71	343-0089-00			7	CLAMP,LOOP:LARGE	80009	343-0089-00
-72	441-1206-00			1	CHAS,ELEC EQPT:POWER	80009	441-1206-00
					**************(ATTACHING PARTS)**********		
-73	211-0504-00			4	SCREW,MACHINE:6-32 X 0.250,PNH STL,CD PL	83385	ORD BY DESCR
-74	210-0006-00			1	WASHER,LOCK:#6 INTL,0.018 THK,STL CD PL	77900	1206-00-00-0541C
-75	211-0538-00			1	SCREW,MACHINE:6-32 X 0.312"100 DEG,FLH	83385	ORD BY DESCR
-76	211-0542-00			3	SCREW,MACHINE:6-32 X 0.312 INCH,TRH STL	83385	ORD BY DESCR
					************(END ATTACHING PARTS)*********		
-77	343-0088-00			4	CLAMP,LOOP:0.062 INCH DIA	80009	343-0088-00
-78	343-0006-00			1	CLAMP,LOOP:0.50 INCH DIAMETER,PLSTC	95987	1-2-6B
					**************(ATTACHING PARTS)**********		
-79	211-0542-00			1	SCREW,MACHINE:6-32 X 0.312 INCH,TRH STL	83385	ORD BY DESCR
-80	210-0457-00			1	NUT,PL,ASSEM WA:6-32 X 0.312,STL CD PL	83385	ORD BY DESCR
					************(END ATTACHING PARTS)*********		
-81	----- -----			1	MICROCIRCUIT,LI:(SEE U9700 REPL)		
					**************(ATTACHING PARTS)**********		
-82	210-0586-00			1	NUT,PL,ASSEM WA:4-40 X 0.25,STL CD PL	T0435	ORD BY DESCR
-83	211-0033-00			1	SCR,ASSEM WSHR:4-40 X 0.312 PNH,STL,CD PL	83385	ORD BY DESCR
					************(END ATTACHING PARTS)*********		
-84	----- -----			3	CAPACITOR:(SEE C9510,C9520,C9530 REPL)		
	200-0256-00	B062962		1	SHLD,CAPACITOR:2.03 INCHES LONG	80009	200-0256-00
	----- -----			-	(CABINET ONLY)		
	200-0256-00	B068626		1	SHLD,CAPACITOR:2.03 INCHES LONG	80009	200-0256-00
	----- -----			-	(RACKMOUNT ONLY)		
					**************(ATTACHING PARTS)**********		
-85	211-0588-00			2	SCREW,MACHINE:6-32 X 0.75 INCH,HEX.HD STL	83385	ORD BY DESCR

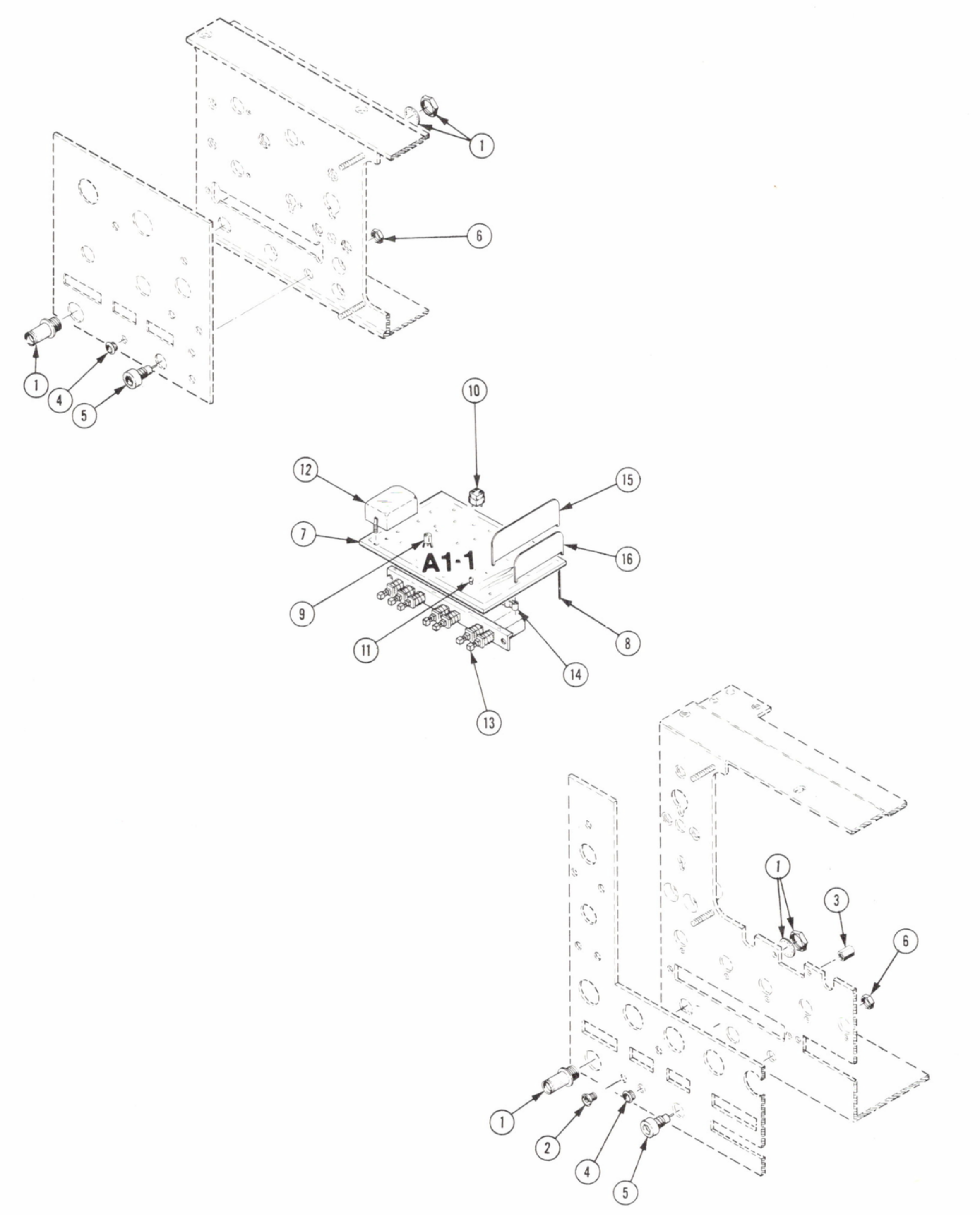
Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
4-86	210-0457-00			2	NUT,PL,ASSEM WA:6-32 X 0.312,STL CD PL	83385	ORD BY DESCR
-87	386-0252-00			1	RETAINER,CAP.:SMALL FIBER	85703	ORD BY DESCR
-88	432-0047-00			1	BASE,CAP.MTG:	80009	432-0047-00
					************(END ATTACHING PARTS)*********		
-89	407-1575-00			1	BRACKET,XFMR:POWER	80009	407-1575-00
					**************(ATTACHING PARTS)***********		
-90	211-0504-00			2	SCREW,MACHINE:6-32 X 0.250,PNH STL,CD PL	83385	ORD BY DESCR
-91	210-0803-00			2	WASHER,FLAT:0.15 ID X 0.032 THK,STL CD	12327	ORD BY DESCR
					************(END ATTACHING PARTS)*********		
-92	----- -----			1	TRANSFORMER:(SEE T9400 REPL)		
					**************(ATTACHING PARTS)***********		
	166-0227-00			2	INS SLV,ELEC:0.187 ID X 1.50 INCH LONG	80009	166-0227-00
-93	166-0229-00	B060000	B063505	2	INS SLV,ELEC:0.187 ID X 3.25 INCH LONG	80009	166-0229-00
	166-0602-00	B063506		2	INSUL SLVG,ELEC:0.19 ID X 2.375 L,MYLAR	80009	166-0602-00
-94	220-0410-00			2	NUT,EXTENDED WA:10-32 X 0.375 INCH,STL	83385	ORD BY DESCR
-95	212-0511-00			2	SCREW,MACHINE:10-32 X 3" LONG,HEX HD STL	83385	ORD BY DESCR
-96	210-0805-00			2	WASHER,FLAT:0.204 ID X 0.438 INCH OD	12327	ORD BY DESCR
-97	210-0813-00			2	WSHR,SHOULDERED:# 10 FIBER	74921	ORD BY DESCR
-98	212-0515-00			2	SCREW,MACHINE:10-32 X 2.250" HEX.HD STL	83385	ORD BY DESCR
-99	210-0812-00			2	WASHER,NONMETAL:#10,FIBER	86445	ORD BY DESCR
					************(END ATTACHING PARTS)*********		
-100	361-0672-00			2	SPACER,XFMR:	80009	361-0672-00
					**************(ATTACHING PARTS)***********		
-101	212-0570-00			2	SCREW,MACHINE:10-32 X 0.625",PNH BRS	000BK	ORD BY DESCR
					************(END ATTACHING PARTS)*********		
-102	----- -----			1	MULTIPLIER:(SEE U9240 REPL)		
					**************(ATTACHING PARTS)***********		
-103	211-0007-00			3	SCREW,MACHINE:4-40 X 0.188,PNH STL,CD PL	83385	ORD BY DESCR
					************(END ATTACHING PARTS)*********		
-104	348-0253-00			2	GROMMET,PLASTIC:BLACK,OBLONG,3.O X 0.925	80009	348-0253-00
-105	210-0202-00			1	TERMINAL,LUG:0.146 ID,LOCKING,BRZ,TIN PL	78189	2104-06-00-2520N
					**************(ATTACHING PARTS)***********		
-106	211-0542-00			1	SCREW,MACHINE:6-32 X 0.312 INCH,TRH STL	83385	ORD BY DESCR
-107	210-0457-00			1	NUT,PL,ASSEM WA:6-32 X 0.312,STL CD PL	83385	ORD BY DESCR
					************(END ATTACHING PARTS)*********		
-108	210-0201-00			1	TERMINAL,LUG:0.12 ID,LOCKING,BRZ TIN PL	86928	A373-157-2
					**************(ATTACHING PARTS)***********		
-109	213-0088-00			1	SCR,TPG,THD CTG:4-24 X 0.25 INCH,PNH STL	83385	ORD BY DESCR
					************(END ATTACHING PARTS)*********		
-110	214-0291-00			1	CONTACT,SPRING:1.188 X 0.375 X 0.25 INCH	80009	214-0291-00
					**************(ATTACHING PARTS)***********		
-111	211-0033-00			1	SCR,ASSEM WSHR:4-40 X 0.312 PNH,STL,CD PL	83385	ORD BY DESCR
-112	210-0586-00			1	NUT,PL,ASSEM WA:4-40 X 0.25,STL CD PL	T0435	ORD BY DESCR
-113	210-0201-00			1	TERMINAL,LUG:0.12 ID,LOCKING,BRZ TIN PL	86928	A373-157-2
					************(END ATTACHING PARTS)*********		
-114	252-0571-00			FT	NEOPRENE EXTR:CHAN,0.234 X 0.156	85471	ORD BY DESCR
-115	337-1643-01	B060000	B063740	1	SHIELD SECT,CRT:REAR	80009	337-1643-01
	337-1643-02	B063740		1	SHIELD,ELEC:	80009	337-1643-02
					**************(ATTACHING PARTS)***********		
-116	211-0033-00			2	SCR,ASSEM WSHR:4-40 X 0.312 PNH,STL,CD PL	83385	ORD BY DESCR
-117	210-0586-00			2	NUT,PL,ASSEM WA:4-40 X 0.25,STL CD PL	T0435	ORD BY DESCR
					************(END ATTACHING PARTS)*********		
-118	136-0273-00			2	LAMPHOLDER:FOR GROOVED BASE	95263	25-06XP11A
					**************(ATTACHING PARTS)***********		
-119	210-0586-00			2	NUT,PL,ASSEM WA:4-40 X 0.25,STL CD PL	T0435	ORD BY DESCR
-120	211-0033-00			2	SCR,ASSEM WSHR:4-40 X 0.312 PNH,STL,CD PL	83385	ORD BY DESCR
-121	210-0994-00			2	WASHER,FLAT:0.125 ID X 0.25" OD,STL	86928	5702-201-20
					************(END ATTACHING PARTS)*********		
-122	386-2876-01			1	SUPPORT,CRT:CENTER	80009	386-2876-01
					**************(ATTACHING PARTS)***********		
-123	213-0104-00			4	SCR,TPG,THD FOR:6-20 X 0.375 INCH,TRH STL	83385	ORD BY DESCR
					************(END ATTACHING PARTS)*********		
-124	----- -----			1	COIL:TRACE ROTATION(SEE L9650 REPL)		

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
4-125	198-2382-00	B060000	B073704	1	WIRE SET,ELEC:	80009	198-2382-00
	----- -----			-	(1480C ONLY)		
	198-2382-02	B073705		1	WIRE SET,ELEC:	80009	198-2382-02
	----- -----			-	(1480C ONLY)		
	198-2382-00	B060000	B082063	1	WIRE SET,ELEC:	80009	198-2382-00
	----- -----			-	(1480R ONLY)		
	198-2382-02	B082064		1	WIRE SET,ELEC:	80009	198-2382-02
	----- -----			-	(1480R ONLY)		
	198-2382-00	B060000	B073704	1	WIRE SET,ELEC:	80009	198-2382-00
	----- -----			-	(1481C ONLY)		
	198-2382-02	B073705		1	WIRE SET,ELEC:	80009	198-2382-02
	----- -----			-	(1481C ONLY)		
	198-2382-00	B060000	B082230	1	WIRE SET,ELEC:	80009	198-2382-00
	----- -----			-	(1481R ONLY)		
	198-2382-02	B082231		1	WIRE SET,ELEC:	80009	198-2382-02
	----- -----			-	(1481R ONLY)		
	198-2382-00	B060000	B073704	1	WIRE SET,ELEC:	80009	198-2382-00
	----- -----			-	(1482C ONLY)		
	198-2382-02	B073705		1	WIRE SET,ELEC:	80009	198-2382-02
	----- -----			-	(1482C ONLY)		
	198-2382-00	B060000	B082230	1	WIRE SET,ELEC:	80009	198-2382-00
	----- -----			-	(1482R ONLY)		
	198-2382-02	B082231		1	WIRE SET,ELEC:	80009	198-2382-02
	----- -----			-	(1482R ONLY)		
	198-2382-00	B060000	B073711	1	WIRE SET,ELEC:	80009	198-2382-00
	----- -----			-	(1485C ONLY)		
	198-2382-02	B073712		1	WIRE SET,ELEC:	80009	198-2382-02
	----- -----			-	(1485C ONLY)		
	198-2382-00	B060000	B082046	1	WIRE SET,ELEC:	80009	198-2382-00
	----- -----			-	(1485R ONLY)		
	198-2382-02	B082047		1	WIRE SET,ELEC:	80009	198-2382-02
	----- -----			-	(1485R ONLY)		
-126	337-2055-00	B060000	B063739	1	SHIELD SECT,CRT:REAR	80009	337-2055-00
	337-2055-01	B063740		1	SHIELD SECT,CRT:REAR	80009	337-2055-01
-127	352-0091-01			2	RTNR,LOOP CLAMP:ELECTRON TUBE	80009	352-0091-01
					**************(ATTACHING PARTS)***********		
-128	211-0590-00			4	SCREW,MACHINE:6-32 X 0.250,PNH,BRS,CD PL	83385	ORD BY DESCR
-129	211-0599-00			2	SCREW,MACHINE:6-32 X 0.750 INCH,FIL SST	83385	ORD BY DESCR
-130	220-0444-00			2	NUT,PLAIN,SQ:6-32 X 0.250 INCH,STL	70318	ORD BY DESCR
					************(END ATTACHING PARTS)*********		
-131	343-0124-00			1	CLAMP,LOOP:ELECTRON TUBE RETAINER	80009	343-0124-00
-132	343-0123-03			1	CLP,ELCTRN TUBE:AL,CD PL	80009	343-0123-03
					**************(ATTACHING PARTS)***********		
-133	211-0600-00			1	SCREW,MACHINE:6-32 X 2 INCH,FIL SST	83385	ORD BY DESCR
					************(END ATTACHING PARTS)*********		
-134	----- -----			1	COIL,Y-AXIS:(SEE L9350 REPL)		
					**************(ATTACHING PARTS)***********		
-135	343-0217-00			1	CLAMP,COIL:Y-AXIS	80009	343-0217-00
-136	213-0088-00			2	SCR,TPG,THD CTG:4-24 X 0.25 INCH,PNH STL	83385	ORD BY DESCR
					************(END ATTACHING PARTS)*********		
-137	386-3456-00			1	SPRT,CRT SHIELD:REAR	80009	386-3456-00
					**************(ATTACHING PARTS)***********		
-138	211-0542-00			5	SCREW,MACHINE:6-32 X 0.312 INCH,TRH STL	83385	ORD BY DESCR
-139	210-0457-00			4	NUT,PL,ASSEM WA:6-32 X 0.312,STL CD PL	83385	ORD BY DESCR
-140	220-0419-00			1	NUT,PLAIN,SQ:6-32 X 0.312 INCH,STL	83385	ORD BY DESCR
					************(END ATTACHING PARTS)*********		
-141	348-0085-00			1	GROMMET,PLASTIC:GRAY,U-SHAPED,0.48 ID	80009	348-0085-00
-142	348-0064-00	B060000	B063739	1	GROMMET,PLASTIC:GRAY,ROUND,0.582 ID	80009	348-0064-00
	348-0532-00	B063740		1	GROMMET,PLASTIC:BLACK,ROUND,0.625 ID	28520	SB-750-10
-143	136-0608-00			1	SKT,PL-IN ELEK:ELECTRON TUBE,14 CONT	80009	136-0608-00
-144	200-0616-00			1	COVER,CRT SKT:1.78 DIA X 0.2 D,WHITE	80009	200-0616-00
-145	386-3090-00	B060000		1	PANEL,REAR:	80009	386-3090-00
-146	220-0477-00			1	NUT,PRESSMOUNT:8-32 X 0.438 OD,STL CD PL	46384	AS-832-2C3
-147	----- -----			1	TRANSISTOR:(SEE Q9180 REPL)		
					**************(ATTACHING PARTS)***********		
-148	210-0586-00			1	NUT,PL,ASSEM WA:4-40 X 0.25,STL CD PL	T0435	ORD BY DESCR
-149	210-1181-00	B060000	B063579	1	WASHER,SHLDR:1.22 ID X 0.2 OD	31223	ORD BY DESCR
	210-1178-00	B063580		1	WASHER,SHLDR:U/W T0-220 TRANSISTOR	49671	DF 137A

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
4-150	210-0994-00			1	WASHER,FLAT:0.125 ID X 0.25" OD,STL	86928	5702-201-20
-151	342-0203-00			1	INSULATOR,PLATE:XSTR,0.675 X 0.625 X 0.001	18722	DF103C
					***********(END ATTACHING PARTS)*********		
-152	----- -----			1	LINE,FILTER:(SEE FL9190 REPL)		
					*************(ATTACHING PARTS)**********		
-153	211-0012-00			2	SCREW,MACHINE:4-40 X 0.375,PNH STL CD PL	83385	ORD BY DESCR
-154	210-0586-00			2	NUT,PL,ASSEM WA:4-40 X 0.25,STL CD PL	T0435	ORD BY DESCR
					***********(END ATTACHING PARTS)*********		
	200-1388-01	B060000	B061448	2	COVER,FUSE:	80009	200-1388-01
	200-0237-03	B061449	B064298	2	COVER,FUSE HLDR:	80009	200-0237-03
	200-0237-04	B064299		2	COVER,FUSE HLDR:PLASTIC,SAFETY CONTROLLED	80009	200-0237-04
-155	352-0362-01	B060000	B063951	1	FUSEHOLDER:W/HARDWARE	75915	345613
	200-2264-00	B063952		1	CAP.,FUSEHOLDER:3AG FUSES	S3629	FEK 031 1666
	210-1039-00	B063952		1	WASHER,LOCK:INT,0.521 ID X 0.625 INCH O	77900	1224-02
	334-2990-00	B062861		1	MARKER,IDENT:CAUTION	80009	334-2990-00
	----- -----			-	(CABINET ONLY)		
	334-2990-00	B068290		1	MARKER,IDENT:CAUTION	80009	334-2990-00
	----- -----			-	(RACKMOUNT ONLY)		
					*************(ATTACHING PARTS)**********		
-156	210-0873-00			1	WASHER,NONMETAL:0.5 ID X 0.688 INCH OD,NPR	70485	ORD BY DESCR
					***********(END ATTACHING PARTS)*********		
-157	200-0817-01			1	COVER,CONN MTG:2.812 X 0.75 AL	80009	200-0817-01
					*************(ATTACHING PARTS)**********		
-158	211-0097-00			2	SCREW,MACHINE:4-40 X 0.312 INCH,PNH STL	83385	ORD BY DESCR
-159	210-0586-00			2	NUT,PL,ASSEM WA:4-40 X 0.25,STL CD PL	T0435	ORD BY DESCR
					***********(END ATTACHING PARTS)*********		
-160	----- -----			1	SWITCH,SLIDE:(SEE S9190 REPL)		
					*************(ATTACHING PARTS)**********		
-161	211-0097-00			2	SCREW,MACHINE:4-40 X 0.312 INCH,PNH STL	83385	ORD BY DESCR
-162	210-0586-00			2	NUT,PL,ASSEM WA:4-40 X 0.25,STL CD PL	T0435	ORD BY DESCR
					***********(END ATTACHING PARTS)*********		
-163	210-0204-00			2	TERMINAL,LUG:0.146 INCH DIA DE,45 DEG BE	78189	2157-06-01-2520N
					*************(ATTACHING PARTS)**********		
-164	210-0457-00			2	NUT,PL,ASSEM WA:6-32 X 0.312,STL CD PL	83385	ORD BY DESCR
					***********(END ATTACHING PARTS)*********		
-165	136-0089-00			1	CONNECTOR,RCPT:9 PIN CHASSIS MOUNT	02660	165-16
					*************(ATTACHING PARTS)**********		
-166	211-0038-00			4	SCREW,MACHINE:4-40 X 0.312,FLH,100 DEG	83385	ORD BY DESCR
-167	210-0586-00			2	NUT,PL,ASSEM WA:4-40 X 0.25,STL CD PL	T0435	ORD BY DESCR
					***********(END ATTACHING PARTS)*********		
-168	----- -----			1	CKT BOARD ASSY:CONNECTOR(SEE A11 REPL)		
					*************(ATTACHING PARTS)**********		
-169	211-0007-00			2	SCREW,MACHINE:4-40 X 0.188,PNH STL,CD PL	83385	ORD BY DESCR
					***********(END ATTACHING PARTS)*********		
	----- -----			-	CKT BOARD ASSY INCLUDES:		
-170	131-0589-00			9	.TERMINAL,PIN:0.46 L X 0.025 SQ	22526	48283-029
-171	129-0353-00			2	POST,ELEC-MECH:0.188 HEX X 0.385 INCH LONG	80009	129-0353-00
-172	131-0955-00			5	CONN,RCPT,ELEC:BNC,FEMALE	13511	31-279
					*************(ATTACHING PARTS)**********		
-173	210-0255-00			5	TERMINAL,LUG:0.391 ID,LOCKING,BRS CD PL	80009	210-0255-00
					***********(END ATTACHING PARTS)*********		
-174	388-4026-00			4	CIRCUIT BOARD:LOOP THRU COMP	80009	388-4026-00
-175	131-0955-00			8	CONN,RCPT,ELEC:BNC,FEMALE	13511	31-279
					*************(ATTACHING PARTS)**********		
-176	210-0255-00			4	TERMINAL,LUG:0.391 ID,LOCKING,BRS CD PL	80009	210-0255-00
-177	346-0118-00			4	STRAP,GROUNDING:BNC	80009	346-0118-00
					***********(END ATTACHING PARTS)*********		

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	 Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
4-178	386-3080-00			2	PLATE,CONN MTG:DELRIN	80009	386-3080-00
					*************(ATTACHING PARTS)***********		
-179	211-0097-00			6	SCREW,MACHINE:4-40 X 0.312 INCH,PNH STL	83385	ORD BY DESCR
-180	213-0054-00			4	SCR,TPG,THD FOR:6-32 X 0.312 INCH,PNH STL	93907	ORD BY DESCR
					***********(END ATTACHING PARTS)*********		
-181	134-0138-00			2	BUTTON,PLUG:SNAP-IN	77132	SS48172
-182	214-2175-00			1	BUTTON,PLUG:SNAP-IN MTG	57771	D3933 NICKEL
183	179-2107-01			1	WIRING HARNESS,:CHASSIS	80009	ORD BY DESCR
-184	131-0707-00			75	.CONTACT,ELEC:22-26 AWG,BRS & CU BE GOLD	22526	47439-000
	131-0621-00			201	.CONNECTOR,TERM:22-26 AWG,BRS & CU BE GOLD	22526	46231-000
	131-0622-00			22	.CONTACT,ELEC:0.577"L,28-32 AWG WIRE	22526	46241-000
	131-0792-00			25	.CONNECTOR,TERM:18-20 AWG,CU BE GOLD PL	22526	46221
-185	210-0774-00			1	.EYELET,METALLIC:0.152 OD X 0.245 INCH L,	80009	210-0774-00
-186	210-0775-00			1	.EYELET,METALLIC:0.126 OD X 0.23 INCH L,	80009	210-0775-00
-187	352-0169-00			1	.HLDR,TERM CONN:2 WIRE,BLACK	80009	352-0169-00
-188	352-0161-08			1	.CONN BODY,PL,EL:3 WIRE GRAY	80009	352-0161-08
-189	352-0163-09			1	.HLDR,TERM CONN:5 WIRE,WHITE	80009	352-0163-09
-190	352-0168-01			1	.HLDR,TERM CONN:10 WIRE,BROWN	80009	352-0168-01
	352-0168-02			1	.HLDR,TERM CONN:10 WIRE,RED	80009	352-0168-02
	352-0168-03			1	.HLDR,TERM CONN:10 WIRE,ORANGE	80009	352-0168-03
	352-0168-04			1	.HLDR,TERM CONN:10 WIRE,YELLOW	80009	352-0168-04
	352-0168-05			1	.HLDR,TERM CONN:10 WIRE,GREEN	80009	352-0168-05
	352-0168-06			1	.HLDR,TERM CONN:10 WIRE,BLUE	80009	352-0168-06
	352-0168-07			1	.HLDR,TERM CONN:10 WIRE,VIOLET	80009	352-0168-07
-191	352-0198-00			9	.HLDR,TERM CONN:2 WIRE BLACK	80009	352-0198-00
-192	352-0199-00			5	.CONN BODY,PL,EL:3 WIRE BLACK	80009	352-0199-00
-193	352-0200-00			3	.HLDR,TERM CONN:4 WIRE BLACK	80009	352-0200-00
-194	352-0201-00			2	.CONN BODY,PL,EL:5 WIRE BLACK	80009	352-0201-00
-195	352-0202-00			5	.HLDR,TERM CONN:6 WIRE BLACK	80009	352-0202-00
-196	352-0203-00			1	.HLDR,TERM CONN:7 WIRE BLACK	80009	352-0203-00
-197	352-0204-00			9	.CONN BODY,PL,EL:8 WIRE BLACK	80009	352-0204-00
-198	352-0205-00			2	.CONN BODY,PL,EL:9 WIRE BLACK	80009	352-0205-00
-199	352-0206-00			3	.HLDR,TERM CONN:10 WIRE BLACK	80009	352-0206-00
	352-0201-01			1	.CONN BODY,PL,EL:5 WIRE BROWN	80009	352-0201-01
	352-0198-03			1	.HLDR,TERM CONN:2 WIRE ORANGE	80009	352-0198-03
	352-0199-03			2	.CONN BODY,PL,EL:3 WIRE ORANGE	80009	352-0199-03
	352-0201-03			1	.CONN BODY,PL,EL:5 WIRE ORANGE	80009	352-0201-03
	352-0199-04			2	.CONN BODY,PL,EL:3 WIRE YELLOW	80009	352-0199-04
	352-0200-04			2	.HLDR,TERM CONN:4 WIRE YELLOW	80009	352-0200-04
	352-0198-05			1	.HLDR,TERM CONN:2 WIRE GREEN	80009	352-0198-05
	352-0199-07			1	.HLDR,TERM CONN:3 WIRE VIOLET	80009	352-0199-07
	352-0200-07			1	.CONN BODY,PL,EL:4 WIRE VIOLET	80009	352-0200-07
	352-0201-07			1	.CONN BODY,PL,EL:5 WIRE VIOLET	80009	352-0201-07
	179-2108-00	B060000	B063505	1	WIRING HARNESS:FRONT PANEL	80009	179-2108-00
	179-2108-01	B063506		1	WIRING HARNESS:FRONT PANEL	80009	179-2108-01
	131-0707-00			72	.CONTACT,ELEC:22-26 AWG,BRS & CU BE GOLD	22526	47439-000
	352-0169-00			1	.HLDR,TERM CONN:2 WIRE,BLACK	80009	352-0169-00
	352-0163-09			1	.HLDR,TERM CONN:5 WIRE,WHITE	80009	352-0163-09
	352-0168-01			1	.HLDR,TERM CONN:10 WIRE,BROWN	80009	352-0168-01
	352-0168-02			1	.HLDR,TERM CONN:10 WIRE,RED	80009	352-0168-02
	352-0168-03			1	.HLDR,TERM CONN:10 WIRE,ORANGE	80009	352-0168-03
	352-0168-05			1	.HLDR,TERM CONN:10 WIRE,GREEN	80009	352-0168-05
	352-0168-06			1	.HLDR,TERM CONN:10 WIRE,BLUE	80009	352-0168-06
	352-0168-07			1	.HLDR,TERM CONN:10 WIRE,VIOLET	80009	352-0168-07

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
					OPTION 01		
-1	131-1315-01			1	CONN,RCPT,ELEC:BNC,FEMALE	24931	28JR 306-1
-2	358-0422-00	B060000	B063505	1	BSHG,MACH.THD:0.25-32 X 0.187" LONG BRS	80009	358-0422-00
	358-0409-00	B063506		1	BSHG,MACH.THD:0.25-32 X 0.159 ID X 0.24	80009	358-0409-00
					*************(ATTACHING PARTS)**********		
-3	129-0582-00			1	SPACER,POST:0.67 LONG X W/0.25-32 THD	80009	129-0582-00
					***********(END ATTACHING PARTS)*********		
-4	358-0301-01			1	BUSHING,SLEEVE:GRAY,MOLDED	80009	358-0301-01
-5	136-0098-00			1	JACK,TIP:BLACK NYLON	74970	105-803
					*************(ATTACHING PARTS)**********		
-6	210-0583-00			1	NUT,PLAIN,HEX:0.25-32 X 0.312 INCH,BRS	73743	2X20317-402
					***********(END ATTACHING PARTS)*********		
-7	----- -----			1	CKT BOARD ASSY:PROBE AMP & VERT SW		
	----- -----			-	(SEE A1-1 REPL)		
-8	131-0589-00			28	.TERMINAL,PIN:0.46 L X 0.025 SQ	22526	48283-029
-9	131-1003-00			1	.CONN,RCPT,ELEC:CKT BD MT,3 PRONG	80009	131-1003-00
-10	136-0220-00			2	.SKT,PL-IN ELEK:TRANSISTOR 3 CONTACT,PCB M	71785	133-23-11-034
-11	136-0252-04			4	.SOCKET,PIN TERM:U/W 0.016-0.018 DIA PINS	22526	75060-007
-12	202-0196-01			1	.CAN,ALUMINUM:1.25 X 0.80 X 0.02 INCH THK	0000G	ORD BY DESCR
-13	----- -----			-	.SWITCH,PUSH:(SEE S2210,S2220,S2230,		
	----- -----			-	.S2250,S2255,S2270,S2280 REPL)		
-14	361-0384-00	B060000	B061819	8	.SPACER,PB SW:0.133L,RED POLYCARBONATE	80009	361-0384-00
	361-0385-00	B061820		8	.SPACER,PB SW:0.164 INCH LONG	80009	361-0385-00
-15	337-2106-00	B060000	B061458	1	.SHIELD,ELEC:2.516 X 1.366 X 0.060 INCH	80009	337-2106-00
	----- -----			-	.(CABINET ONLY)		
	337-2106-01	B061459		1	.SHIELD,ELEC:CIRCUIT BOARD	80009	337-2106-01
	----- -----			-	.(CABINET ONLY)		
	337-2106-00	B060000	B063609	1	.SHIELD,ELEC:2.516 X 1.366 X 0.060 INCH	80009	337-2106-00
	----- -----			-	.(RACKMOUNT ONLY)		
	337-2106-01	B063610		1	.SHIELD,ELEC:CIRCUIT BOARD	80009	337-2106-01
	----- -----			-	.(RACKMOUNT ONLY)		
-16	337-0896-00			1	.PLATE,ELEC SHLD:CKT BOARD MOUNT,BRS	80009	337-0896-00
					OPTION 03		
	331-0393-02			1	SCALE,CRT:CCIR,CLEAR	80009	331-0393-02
	331-0393-08			1	SCALE,CRT:EXT,NTSC,A 100%,CLEAR	80009	331-0393-08
	331-0393-17	B073222		1	SCALE,CRT:IEEE STANDARD 511-1979	80009	331-0393-17
	----- -----			-	(CABINET ONLY)		
	331-0393-17	B079714		1	SCALE,CRT:IEEE STANDARD 511-1979	80009	331-0393-17
	----- -----			-	(RACKMOUNT ONLY)		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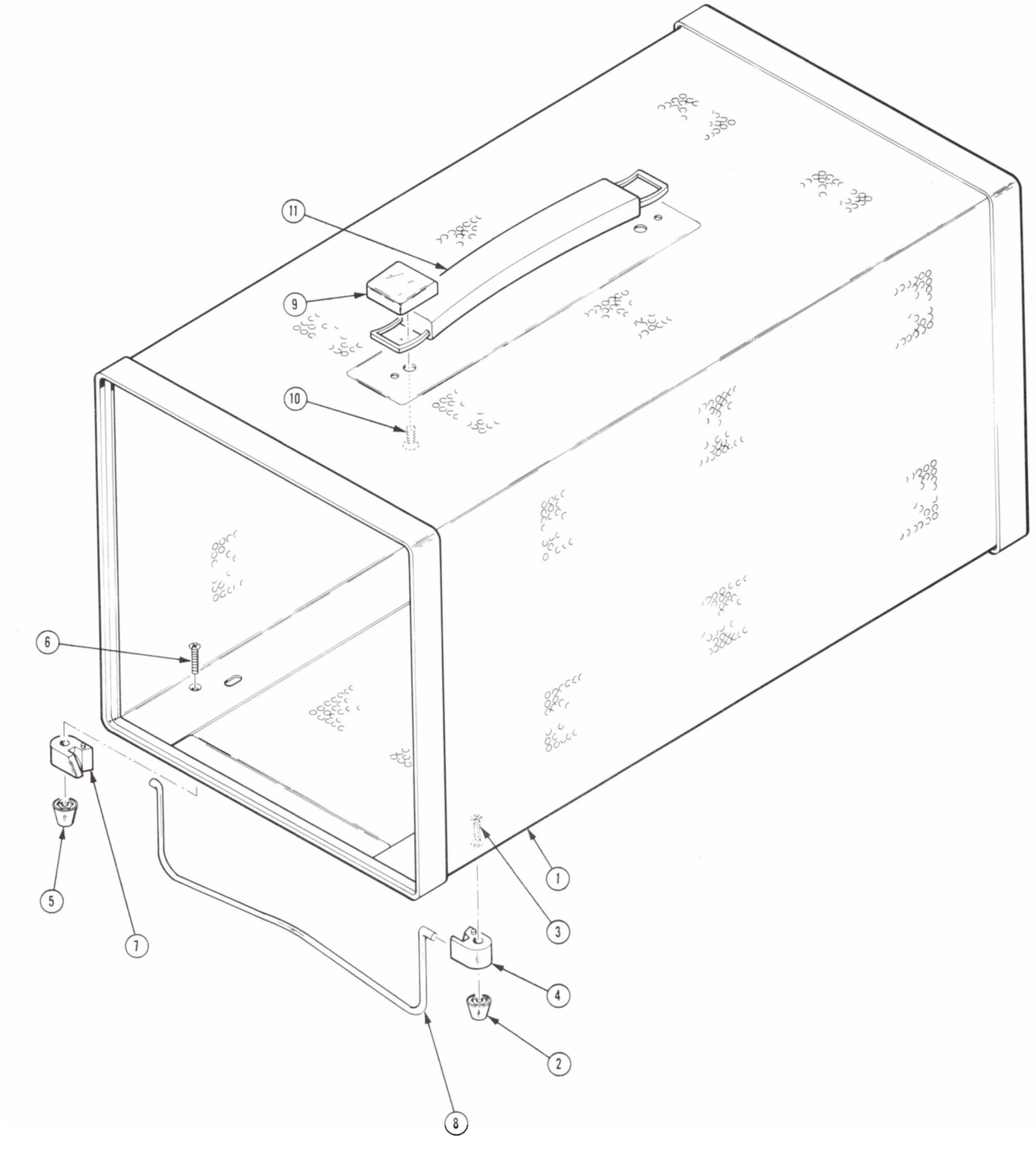
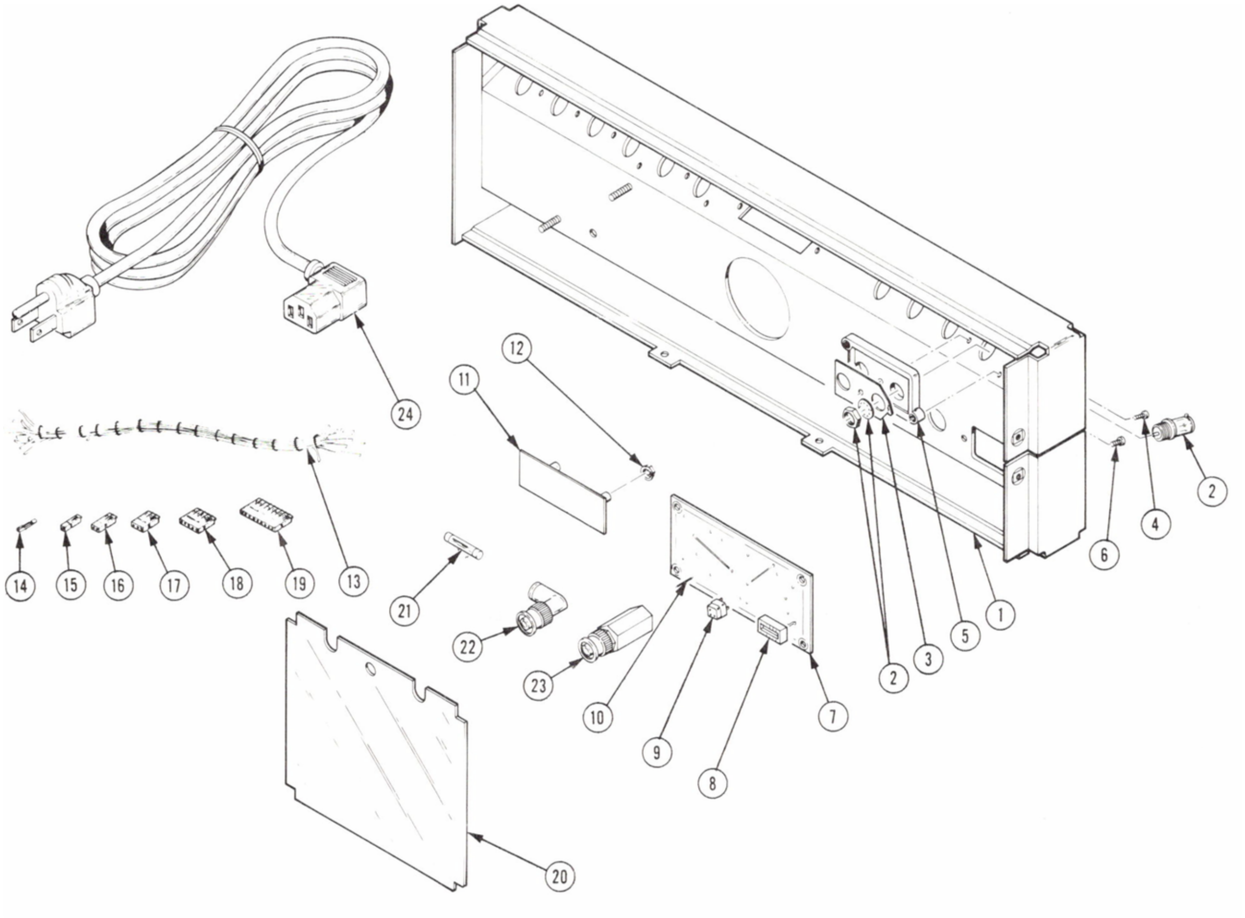


Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
					OPTION 02		
	016-0084-00			1	CABINET,SCOPE:	80009	016-0084-00
-1	344-0098-00			2	.CLIP,DECORATIVE:CARRYING HANDLE,STL NP	80009	344-0098-00
-2	367-0037-00			1	.HANDLE,CARRYING:	80009	367-0037-00
					.************(ATTACHING PARTS)***********		
-3	212-0622-00			2	.SCREW,SLFLKG:10-32 X 0.375,100 DEG FLH,S	04866	M39AS1032
					.**********(END ATTACHING PARTS)*********		
-4	348-0027-00			2	.HINGE BLOCK,STA:RIGHT	80009	348-0027-00
-5	348-0187-00			2	.FOOT,CABINET:0.780 X 1.650 INCH LONG	80009	348-0187-00
					.************(ATTACHING PARTS)***********		
-6	211-0522-00			2	.SCREW,MACHINE:6-32 X 0.625 FLH,100 DEG ST	83385	ORD BY DESCR
					.**********(END ATTACHING PARTS)*********		
-7	348-0026-00			2	.HINGE BLOCK,STA:LEFT	80009	348-0026-00
-8	348-0187-00			2	.FOOT,CABINET:0.780 X 1.650 INCH LONG	80009	348-0187-00
					.************(ATTACHING PARTS)***********		
-9	211-0522-00			2	.SCREW,MACHINE:6-32 X 0.625 FLH,100 DEG ST	83385	ORD BY DESCR
					.**********(END ATTACHING PARTS)*********		

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
					OPTION 04 & 05		
	131-0566-00			4	BUS CONDUCTOR:DUMMY RES,2.375,22 AWG	57668	JWW-0200E0
	136-0514-00			1	SKT,PL-IN ELEC:MICROCIRCUIT,8 DIP	09922	DILB8P-108
	136-0220-00			3	SKT,PL-IN ELEK:TRANSISTOR 3 CONTACT,PCB MT	71785	133-23-11-034
-1	386-3082-00			1	PANEL,REAR:	80009	386-3082-00
-2	131-0955-00			2	CONN,RCPT,ELEC:BNC,FEMALE	13511	31-279
-3	346-0118-00			1	STRAP,GROUNDING:BNC	80009	346-0118-00
					*************(ATTACHING PARTS)**********		
-4	213-0054-00			1	SCR,TPG,THD FOR:6-32 X 0.312 INCH,PNH STL	93907	ORD BY DESCR
					***********(END ATTACHING PARTS)*********		
-5	386-3088-00			1	PLATE,CONN MTG:DELRIN	80009	386-3088-00
					*************(ATTACHING PARTS)**********		
-6	211-0097-00			2	SCREW,MACHINE:4-40 X 0.312 INCH,PNH STL	83385	ORD BY DESCR
					***********(END ATTACHING PARTS)*********		
-7	----- -----			1	CKT BOARD ASSY:FRONT PANEL CONNECTOR		
	----- -----			-	(SEE A7A1 REPL)		
-8	136-0269-02			2	.SKT,PL-IN ELEK:MICROCIRCUIT,14 DIP	09922	DILB14P-108T
-9	136-0220-00			3	.SKT,PL-IN ELEK:TRANSISTOR 3 CONTACT,PCB M	71785	133-23-11-034
-10	131-0589-00			7	.TERMINAL,PIN:0.46 L X 0.025 SQ	22526	48283-029
	131-0608-00			69	.TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD	22526	48283-036
-11	200-1888-00			1	COVER,CONN HOLE:PROBE VTR	80009	200-1888-00
					*************(ATTACHING PARTS)**********		
-12	220-0743-00			2	NUT,STAMPED:0.187 THD X 0.217 H,CD PL	80009	220-0743-00
					***********(END ATTACHING PARTS)*********		
-13	179-2315-00			1	WIRING HARNESS:VTR	80009	179-2315-00
-14	131-0621-00			7	.CONNECTOR,TERM:22-26 AWG,BRS & CU BE GOLD	22526	46231-000
	131-0622-00			5	.CONTACT,ELEC:0.577"L,28-32 AWG WIRE	22526	46241-000
	131-0707-00			9	.CONTACT,ELEC:22-26 AWG,BRS & CU BE GOLD	22526	47439-000
	131-0792-00			3	.CONNECTOR,TERM:18-20 AWG,CU BE GOLD PL	22526	46221
-15	352-0197-00			3	.CONN BODY,PL,EL:1 WIRE BLACK	80009	352-0197-00
-16	352-0198-00			2	.HLDR,TERM CONN:2 WIRE BLACK	80009	352-0198-00
-17	352-0199-00			1	.CONN BODY,PL,EL:3 WIRE BLACK	80009	352-0199-00
-18	352-0201-00			1	.CONN BODY,PL,EL:5 WIRE BLACK	80009	352-0201-00
-19	352-0167-00			1	.HLDR,TERM CONN:9 WIRE,BLACK	80009	352-0167-00
-20	331-0393-00			1	SCALE,CRT:BLANK,CLEAR	80009	331-0393-00
	331-0393-05			1	SCALE,CRT:CCIR K FACTOR ,VISUAL,CLEAR	80009	331-0393-05
-21	159-0018-00			1	FUSE,CARTRIDGE:3AG,0.8A,250V,SLOW-BLOW	71400	MDL 8/10
	159-0031-00			1	FUSE,CARTRIDGE:3AG,0.4A,250V,SLOW-BLOW	71400	MDL 4/10
-22	103-0031-00			2	ADAPTER,CONN:BNC RIGHT ANGLE	95712	2200-2
-23	011-0102-00			1	TERMN,COAXIAL:75 OHM,BNC	80009	011-0102-00
-24	161-0104-00			1	CABLE ASSY,PWR,:3 WIRE,98.0 L,W/RTANG CONN	S3109	ORD BY DESCR
	331-0393-00			1	SCALE,CRT:BLANK,CLEAR	80009	331-0393-00
	331-0393-01			1	SCALE,CRT:NTSC,CLEAR	80009	331-0393-01
	331-0393-02			1	SCALE,CRT:CCIR,CLEAR	80009	331-0393-02
	331-0393-05			1	SCALE,CRT:CCIR K FACTOR,VISUAL,CLEAR	80009	331-0393-05
	331-0393-07			1	SCALE,CRT:CCIR K FACTOR,PHOTO,CLEAR	80009	331-0393-07
	331-0393-08			1	SCALE,CRT:EXT,NTSC,A 100%,CLEAR	80009	331-0393-08
	331-0393-09			1	SCALE,CRT:EXT,NTSC B 100%,CLEAR	80009	331-0393-09
	331-0393-10			1	SCALE,CRT:EXT,NTSC A PHOTO,CLEAR	80009	331-0393-10
	331-0393-11	B060000	B073221	1	SCALE,CRT:EXT,NTSC B PHOTO,CLEAR	80009	331-0393-11
	331-0393-17	B073222		1	SCALE,CRT:IEEE STANDARD 511-1979	80009	331-0393-17
	331-0393-18	B073222		1	SCALE,CRT:IEEE STANDARD 511-1979,PHOT	80009	331-0393-18



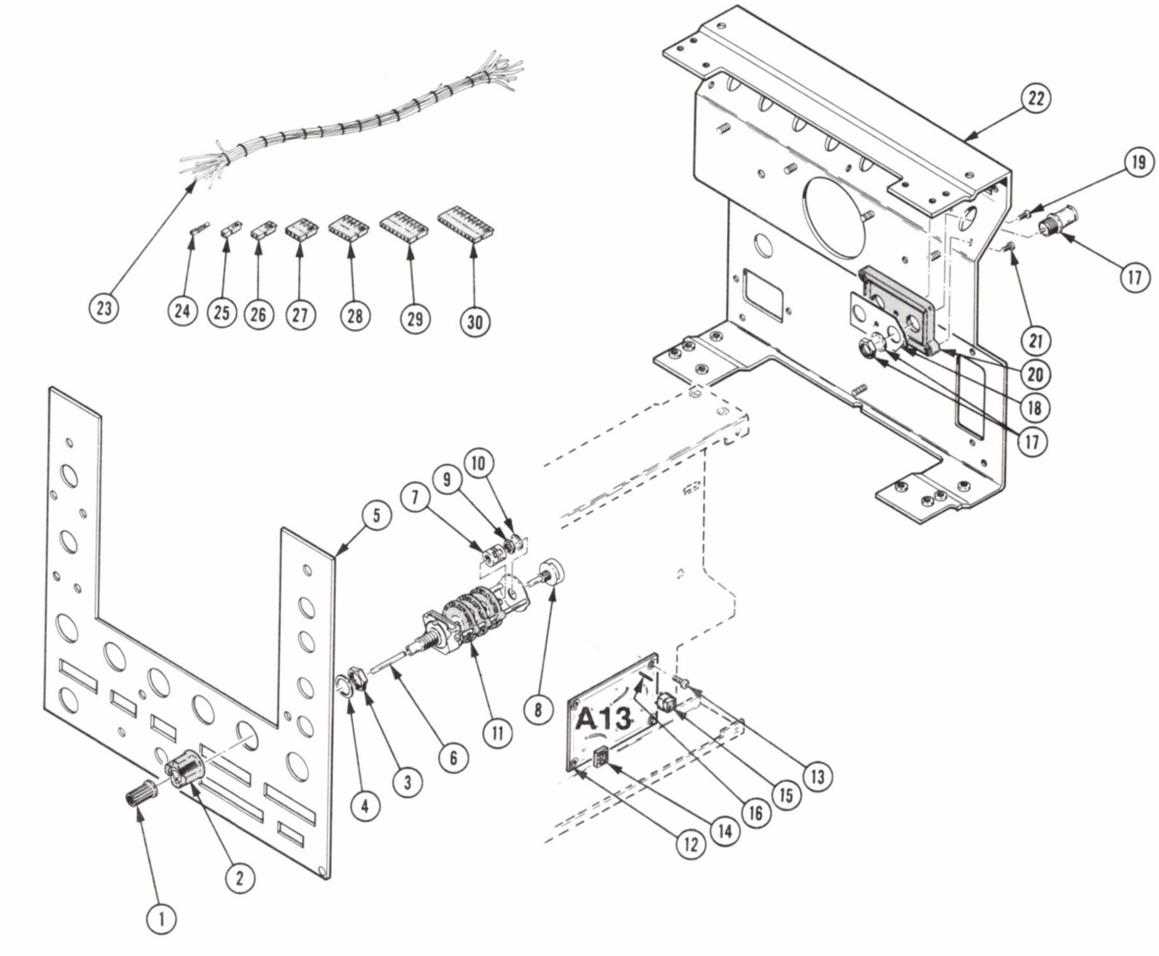


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Fig. & Index No.	Tektronix Part No.	Serial/Model No.		Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
		Eff	Dscont				
					OPTION 07 CABINET		
-1	366-1189-00			1	KNOB:GY,0.127 ID X 0.5 OD X 0.53	80009	366-1189-00
	213-0153-00			1	.SETSCREW:5-40 X 0.125,STL BK OXD,HEX	000CY	ORD BY DESCR
-2	366-1170-01			1	KNOB:GRAY,4 SIDED	80009	366-1170-01
	213-0153-00			2	.SETSCREW:5-40 X 0.125,STL BK OXD,HEX	000CY	ORD BY DESCR
					*************(ATTACHING PARTS)***********		
-3	210-0590-00			1	NUT,PLAIN,HEX.:0.375-32 X 0.438" BRS	73743	2X28269-402
-4	210-0978-00			1	WASHER,FLAT:0.375 ID X 0.50 INCH OD,STL	12327	ORD BY DESCR
					***********(END ATTACHING PARTS)*********		
-5	333-1962-03			1	PANEL,FRONT:1480C	80009	333-1962-03
	333-1964-03			1	PANEL,FRONT:1481C	80009	333-1964-03
	333-1966-04			1	PANEL,FRONT:1482C	80009	333-1966-04
	333-1970-03			1	PANEL,FRONT:1485C	80009	333-1970-03
-6	384-1484-00	B060000	B061464	1	EXTENSION SHAFT:3.0 L X 0.125 OD,SST	80009	384-1484-00
-7	376-0051-00	B060000	B061464	1	CPLG,SHAFT,FLEX:0.127 ID X 0.375 ID DELRIN	80009	376-0051-00
	213-0022-00			4	.SETSCREW:4-40 X 0.188 INCH,HEX SOC S	74445	ORD BY DESCR
-8	----- -----			1	RESISTOR,VAR:(SEE R9891 REPL)		
					*************(ATTACHING PARTS)***********		
-9	210-0583-00			1	NUT,PLAIN,HEX:0.25-32 X 0.312 INCH,BRS	73743	2X20317-402
-10	210-0046-00			1	WASHER,LOCK:0.261 ID,INTL,0.018 THK,BRS	77900	1214-05-00-0541C
					***********(END ATTACHING PARTS)*********		
-11	260-1818-00			1	SWITCH,ROTARY:9 POLE,6 POSN,45 DEG	80009	260-1818-00
-12	----- -----			1	CKT BOARD ASSY:SLOW SWEEP(SEE A13 REPL)		
					*************(ATTACHING PARTS)***********		
-13	211-0007-00			4	SCREW,MACHINE:4-40 X 0.188,PNH STL,CD PL	83385	ORD BY DESCR
					***********(END ATTACHING PARTS)*********		
	----- -----			-	CKT BOARD ASSY INCLUDES:		
-14	131-0589-00			20	.TERMINAL,PIN:0.46 L X 0.025 SQ	22526	48283-029
-15	136-0220-00	B060000	B067590	10	.SKT,PL-IN ELEK:TRANSISTOR 3 CONTACT,PCB M	71785	133-23-11-034
-16	136-0514-00			1	.SKT,PL-IN ELEC:MICROCIRCUIT,8 DIP	09922	DILB8P-108
-17	131-0955-00			2	CONN,RCPT,ELEC:BNC,FEMALE	13511	31-279
-18	346-0118-00			1	STRAP,GROUNDING:BNC	80009	346-0118-00
					*************(ATTACHING PARTS)***********		
-19	213-0054-00			1	SCR,TPG,THD FOR:6-32 X 0.312 INCH,PNH STL	93907	ORD BY DESCR
					***********(END ATTACHING PARTS)*********		
-20	386-3088-00			1	PLATE,CONN MTG:DELRIN	80009	386-3088-00
					*************(ATTACHING PARTS)***********		
-21	211-0097-00			2	SCREW,MACHINE:4-40 X 0.312 INCH,PNH STL	83385	ORD BY DESCR
					***********(END ATTACHING PARTS)*********		
-22	386-3082-01			1	PANEL,REAR:	80009	386-3082-01
-23	179-2412-00			1	WIRING HARNESS,:SLOW SWEEP	80009	179-2412-00
-24	131-0621-00			39	.CONNECTOR,TERM:22-26 AWG,BRS & CU BE GOLD	22526	46231-000
	131-0622-00			1	.CONTACT,ELEC:0.577"L,28-32 AWG WIRE	22526	46241-000
	131-0707-00			1	.CONTACT,ELEC:22-26 AWG,BRS & CU BE GOLD	22526	47439-000
	131-0965-00			12	.CONTACT,ELEC:O.25" SQ,22-26 AWG WIRE	22526	47792
-25	352-0171-00			1	.HLDR,TERM CONN:1 WIRE,BLACK	80009	352-0171-00
	352-0197-00			1	.CONN BODY,PL,EL:1 WIRE BLACK	80009	352-0197-00
-26	352-0198-00			3	.HLDR,TERM CONN:2 WIRE BLACK	80009	352-0198-00
-27	352-0162-00			1	.HLDR,TERM CONN:4 WIRE,BLACK	80009	352-0162-00
	352-0200-00			2	.HLDR,TERM CONN:4 WIRE BLACK	80009	352-0200-00
-28	352-0202-00			2	.HLDR,TERM CONN:6 WIRE BLACK	80009	352-0202-00
-29	352-0166-00			1	.HLDR,TERM CONN:8 WIRE,BLACK	80009	352-0166-00
-30	352-0206-00			1	.HLDR,TERM CONN:10 WIRE BLACK	80009	352-0206-00

Fig. & Index No.	Tektronix Part No.	Serial/Model No.		Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
		Eff	Dscont				
					OPTION 07 RACKMOUNT		
-1	366-1189-00			1	KNOB:GY,0.127 ID X 0.5 OD X 0.53	80009	366-1189-00
	213-0153-00			1	.SETSCREW:5-40 X 0.125,STL BK OXD,HEX	000CY	ORD BY DESCR
-2	366-1170-01			1	KNOB:GRAY,4 SIDED	80009	366-1170-01
	213-0153-00			2	.SETSCREW:5-40 X 0.125,STL BK OXD,HEX	000CY	ORD BY DESCR
					**************(ATTACHING PARTS)***********		
-3	210-0590-00			1	NUT,PLAIN,HEX.:0.375-32 X 0.438" BRS	73743	2X28269-402
-4	210-0978-00			1	WASHER,FLAT:0.375 ID X 0.50 INCH OD,STL	12327	ORD BY DESCR
					************(END ATTACHING PARTS)*********		
-5	333-1985-03			1	PANEL,FRONT:RIGHT,1480R	80009	333-1985-03
	333-1910-04			1	PANEL,FRONT:1481R	80009	333-1910-04
	333-1986-04			1	PANEL,FRONT:1482R	80009	333-1986-04
-6	384-1421-00	B060000	B063814	1	EXTENSION SHAFT:2.85 X 0.125,SST	80009	384-1421-00
-7	376-0051-00	B060000	B063814	1	CPLG,SHAFT,FLEX:0.127 ID X 0.375 ID DELRIN	80009	376-0051-00
	213-0022-00			4	.SETSCREW:4-40 X 0.188 INCH,HEX SOC S	74445	ORD BY DESCR
-8	----- -----			1	RESISTOR,VAR:(SEE R9891 REPL)		
					**************(ATTACHING PARTS)***********		
-9	210-0583-00			1	NUT,PLAIN,HEX:0.25-32 X 0.312 INCH,BRS	73743	2X20317-402
-10	210-0046-00			1	WASHER,LOCK:0.261 ID,INTL,0.018 THK,BRS	77900	1214-05-00-0541C
					************(END ATTACHING PARTS)*********		
-11	260-1818-00			1	SWITCH,ROTARY:9 POLE,6 POSN,45 DEG	80009	260-1818-00
-12	407-1789-00			1	BRACKET,CKT BD:ALUMINUM	80009	407-1789-00
					**************(ATTACHING PARTS)***********		
-13	211-0038-00			4	SCREW,MACHINE:4-40 X 0.312,FLH,100 DEG	83385	ORD BY DESCR
-14	211-0007-00			4	SCREW,MACHINE:4-40 X 0.188,PNH STL,CD PL	83385	ORD BY DESCR
					************(END ATTACHING PARTS)*********		
-15	----- -----			1	CKT BOARD ASSY:SLOW SWEEP(SEE A13 REPL)		
-16	131-0589-00			20	.TERMINAL,PIN:0.46 L X 0.025 SQ	22526	48283-029
-17	136-0220-00	B060000	B062664	10	.SKT,PL-IN ELEK:TRANSISTOR 3 CONTACT,PCB M	71785	133-23-11-034
-18	136-0514-00			1	.SKT,PL-IN ELEC:MICROCIRCUIT,8 DIP	09922	DILB8P-108
-19	131-0955-00			2	CONN,RCPT,ELEC:BNC,FEMALE	13511	31-279
-20	346-0118-00			1	STRAP,GROUNDING:BNC	80009	346-0118-00
					**************(ATTACHING PARTS)***********		
-21	213-0054-00			1	SCR,TPG,THD FOR:6-32 X 0.312 INCH,PNH STL	93907	ORD BY DESCR
					************(END ATTACHING PARTS)*********		
-22	386-3088-00			1	PLATE,CONN MTG:DELRIN	80009	386-3088-00
					**************(ATTACHING PARTS)***********		
-23	211-0097-00			2	SCREW,MACHINE:4-40 X 0.312 INCH,PNH STL	83385	ORD BY DESCR
					************(END ATTACHING PARTS)*********		
-24	386-3090-01			1	PANEL,REAR:	80009	386-3090-01
-25	179-2413-00			1	WIRING HARNESS,:SLOW SWEEP	80009	179-2413-00
-26	131-0621-00			39	.CONNECTOR,TERM:22-26 AWG,BRS & CU BE GOLD	22526	46231-000
	131-0622-00			1	.CONTACT,ELEC:0.577"L,28-32 AWG WIRE	22526	46241-000
	131-0707-00			1	.CONTACT,ELEC:22-26 AWG,BRS & CU BE GOLD	22526	47439-000
	131-0965-00			12	.CONTACT,ELEC:O.25" SQ,22-26 AWG WIRE	22526	47792
-27	352-0171-00			1	.HLDR,TERM CONN:1 WIRE,BLACK	80009	352-0171-00
	352-0197-00			1	.CONN BODY,PL,EL:1 WIRE BLACK	80009	352-0197-00
-28	352-0198-00			3	.HLDR,TERM CONN:2 WIRE BLACK	80009	352-0198-00
-29	352-0162-00			1	.HLDR,TERM CONN:4 WIRE,BLACK	80009	352-0162-00
	352-0200-00			2	.HLDR,TERM CONN:4 WIRE BLACK	80009	352-0200-00
-30	352-0202-00			2	.HLDR,TERM CONN:6 WIRE BLACK	80009	352-0202-00
-31	352-0166-00			1	.HLDR,TERM CONN:8 WIRE,BLACK	80009	352-0166-00
-32	352-0206-00			1	.HLDR,TERM CONN:10 WIRE BLACK	80009	352-0206-00

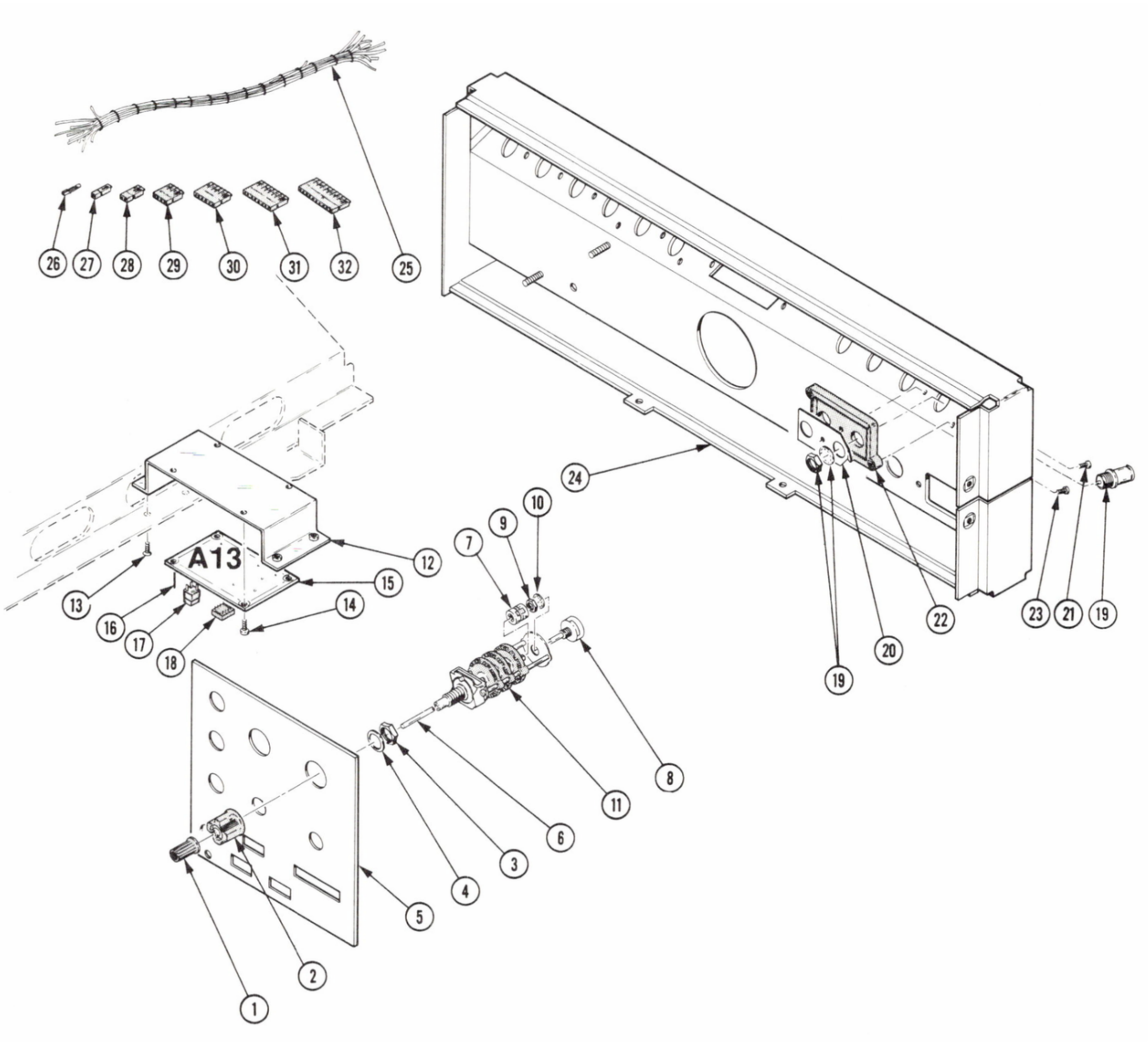
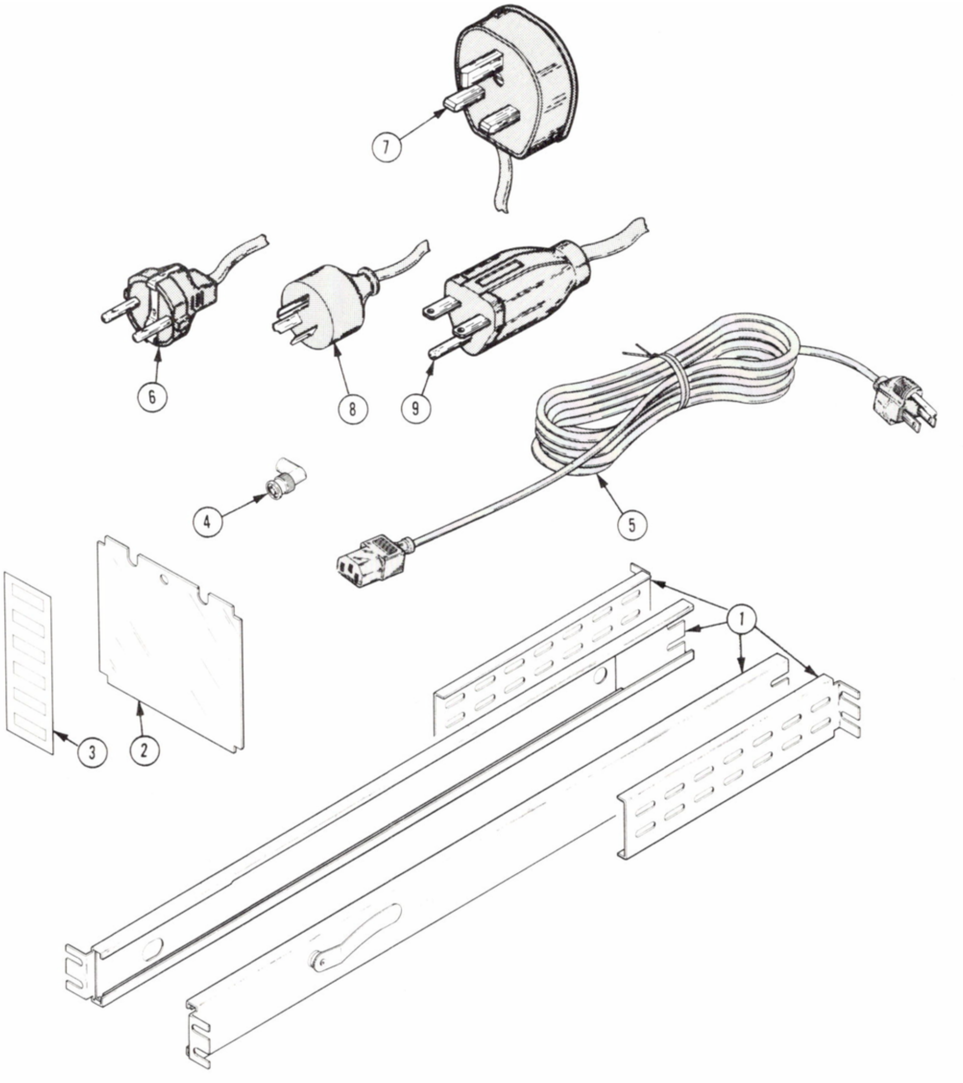

A13

Fig. & Index No.	Tektronix Part No.	Serial/Model No.		Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
		Eff	Dscont				
					STANDARD ACCESSORIES		
-1	351-0195-00	B060000	B068705	PR	SLIDE,DWR,EXT:SLIDE,PAIR	06666	C719
	351-0195-01	B068706		PR	SLIDE,DWR,EXT:W/CLOSED MOUNTING SLOTS	80009	351-0195-01
-2	331-0393-09			1	SCALE,CRT:EXT,NTSC B 100%,CLEAR	80009	331-0393-09
	331-0393-01			1	SCALE,CRT:NTSC,CLEAR	80009	331-0393-01
	331-0393-05			1	SCALE,CRT:CCIR K FACTOR ,VISUAL,CLEAR	80009	331-0393-05
	331-0393-07			1	SCALE,CRT:CCIR K FACTOR,PHOTO,CLEAR	80009	331-0393-07
	331-0393-10			1	SCALE,CRT:EXT,NTSC A PHOTO,CLEAR	80009	331-0393-10
	331-0393-11			1	SCALE,CRT:EXT,NTSC B PHOTO,CLEAR	80009	331-0393-11
-3	334-2205-00			1	MKR SET,IDENT:MKD VOLTAGE CHANGE	80009	334-2205-00
-4	103-0031-00			2	ADAPTER,CONN:BNC RIGHT ANGLE	95712	2200-2
	134-0049-00			1	CONN,PLUG,ELEC:MS TYPE,20 MALE	02660	165-13
-5	161-0066-00			1	CABLE ASSY,PWR,:3,18 AWG,115V,98.0 L	16428	CH8481,FH8481
-6	161-0066-09	B073100		1	CABLE ASSY,PWR:3,0.75MM SQ,220V,99.0 L	S3109	86511000
	----- -----			-	(CABINET ONLY-OPTION A1 EUROPEAN ONLY)		
	161-0066-09	B078933		1	CABLE ASSY,PWR:3,0.75MM SQ,220V,99.0 L	S3109	86511000
	----- -----			-	(RACKMOUNT ONLY,OPTION A1 EUROPEAN ONLY)		
-7	161-0066-10	B073100		1	CABLE ASSY,PWR:3,0.75MM SQ,240V,96.0 L	S3109	ORD BY DESCR
	----- -----			-	(CABINET ONLY,		
	----- -----			-	OPTION A2 UNITED KINGDOM ONLY)		
	161-0066-10	B078933		1	CABLE ASSY,PWR:3,0.75MM SQ,240V,96.0 L	S3109	ORD BY DESCR
	----- -----			-	(RACKMOUNT ONLY,		
	----- -----			-	OPTION A2 UNITED KINGDOM ONLY)		
-8	161-0066-11	B073100		1	CABLE ASSY,PWR:3,0.75MM,240V,96.0L	S3109	SAA/3-003CCFC3X0
	----- -----			-	(CABINET ONLY,OPTION A3 AUSTRALIAN ONLY)		
	161-0066-11	B078933		1	CABLE ASSY,PWR:3,0.75MM,240V,96.0L	S3109	SAA/3-003CCFC3X0
	----- -----			-	(RACKMOUNT ONLY,		
	----- -----			-	OPTION A3 AUSTRALIAN ONLY)		
-9	161-0066-12	B073100		1	CABLE ASSY,PWR:3,18 AWG,240V,96.0 L	70903	CH-77893
	----- -----			-	(CABINET ONLY,		
	----- -----			-	OPTION A4 NORTH AMERICAN ONLY)		
	161-0066-12	B078933		1	CABLE ASSY,PWR:3,18 AWG,240V,96.0 L	70903	CH-77893
	----- -----			-	(RACKMOUNT ONLY,		
	----- -----			-	OPTION A4 NORTH AMERICAN ONLY)		
	070-2338-00			1	MANUAL,TECH:INSTRUCTION	80009	070-2338-00



MANUAL CHANGE INFORMATION

At Tektronix, we continually strive to keep up with latest electronic developments by adding circuit and component improvements to our instruments as soon as they are developed and tested.

Sometimes, due to printing and shipping requirements, we can't get these changes immediately into printed manuals. Hence, your manual may contain new change information on following pages.

A single change may affect several sections. Since the change information sheets are carried in the manual until all changes are permanently entered, some duplication may occur. If no such change pages appear following this page, your manual is correct as printed.

Tektronix
COMMITTED TO EXCELLENCE

MANUAL CHANGE INFORMATION

Date: 2-11-81 Change Reference: C100/281

Product: GENERAL Manual Part No.: GENERAL

DESCRIPTION

WARNING

During rackmount installation, interchanging the left and right slide-out track assemblies defeats the extension stop (safety latch) feature of the tracks. Equipment could, when extended, come out of the slides and fall from the rack, possibly causing personal injury and equipment damage.

When mounting the supplied slide-out tracks, inspect both assemblies to find the LH (left hand) and RH (right hand) designations to determine correct placement. Install the LH assembly to your left side as you face the front of the rack and install the RH assembly to your right side. Refer to the rackmounting instructions in this manual for complete information.

TEKTRONIX MANUAL CHANGE NOTICE

Date: 1-17-85
Product: 1480-Series Manual Part No.: 070-2338-00
Change Ref: M56374 Product Group: 20

DESCRIPTION

EFF SN 1480C B094090
1480R B104065

ELECTRICAL PARTS AND SCHEMATIC CHANGES

CHANGE TO:

A2	670-3485-39	VERTICAL AMPLIFIER
A2	670-3485-40	CKT BOARD ASSY:VERTICAL AMPLIFIER (1480C, 1482C, OPTION 04)
A2	670-3485-42	CKT BOARD ASSY:VERTICAL AMPLIFIER (1481,1482,1485)
A2	670-3485-43	CKT BOARD ASSY:VERTICAL AMPLIFIER (1481C,1482C,1485C OPTION 04 & 1485C OPTION 05)
C1237	283-0663-00	CAP.,FXD,MICA DI:16.8PF,+/0.5PF,500V
C1437	281-0153-00	CAP.,VAR AIR DI:1.7-10PF,250V
C1567	281-0153-00	CAP.,VAR AIR DI:1.7-10PF,250V
Q1136	151-0192-00	TRANSISTOR:SELECTED
Q1137	151-0192-00	TRANSISTOR:SELECTED
Q1141	151-0192-00	TRANSISTOR:SELECTED
Q1142	151-0192-00	TRANSISTOR:SELECTED
R1136	317-0100-00	RES.,FXD,CMPSN:10 OHM,5%,0.125W
R1137	317-0100-00	RES.,FXD,CMPSN:10 OHM,5%,0.125W
R1141	317-0100-00	RES.,FXD,CMPSN:10 OHM,5%,0.125W
R1142	317-0100-00	RES.,FXD,CMPSN:10 OHM,5%,0.125W
R1851	315-0331-00	RES.,FXD,CMPSN:330 OHM,5%,0.25W

The above parts are located on the A2 VERTICAL AMPLIFIER BOARD and shown on diagrams: 1, 2 & 3

A4	670-3488-34	CKT BOARD ASSY:SWEEP OUTPUT
C4620	281-0153-00	CAP.,VAR AIR DI:1.7-10PF,250V
R4022	321-0632-00	RES.,FXD,FILM:9.41K OHM,0.5%,0.125W

The above parts are located on the A4 SWEEP OUTPUT BOARD and shown on diagrams 10 & 11